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WAR MACHINE

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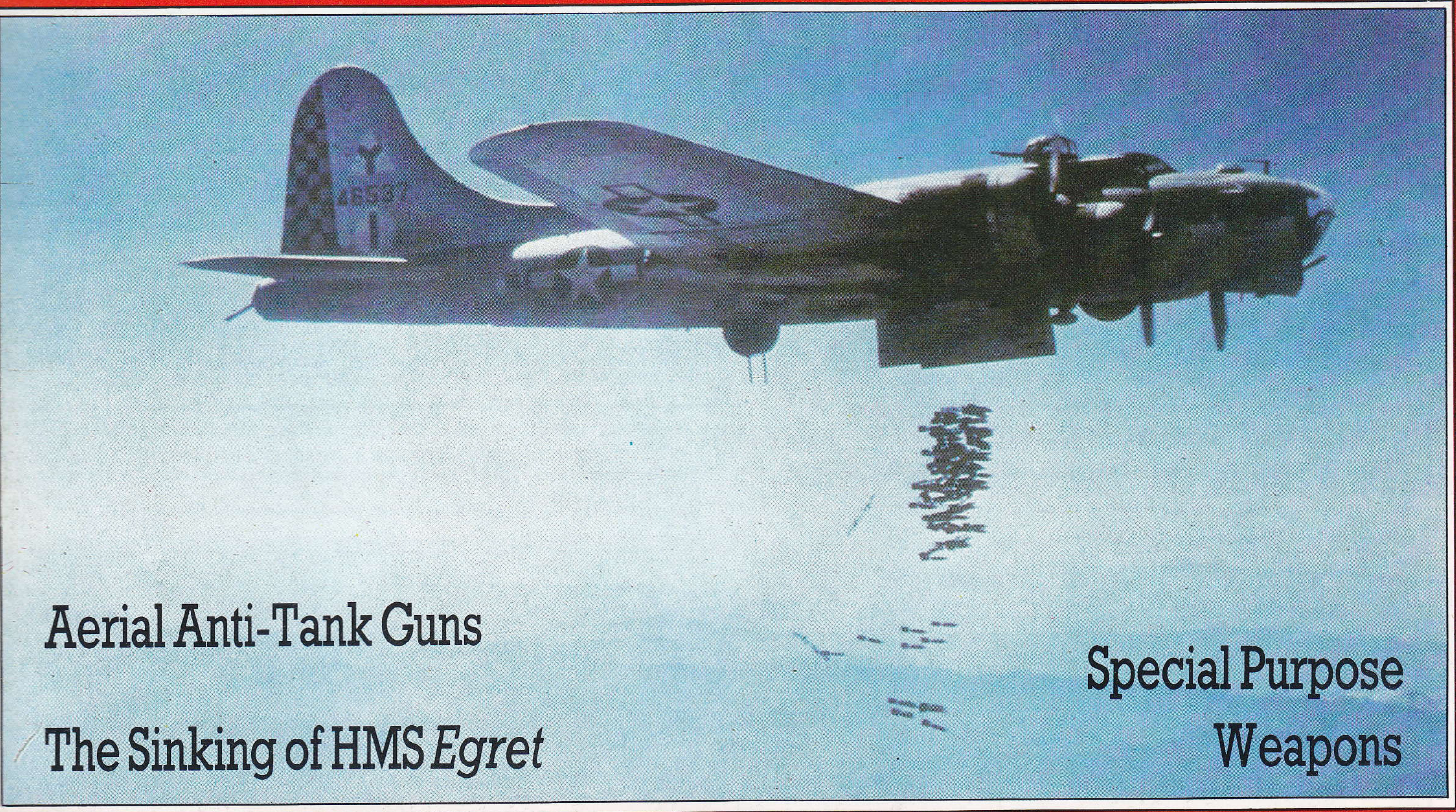

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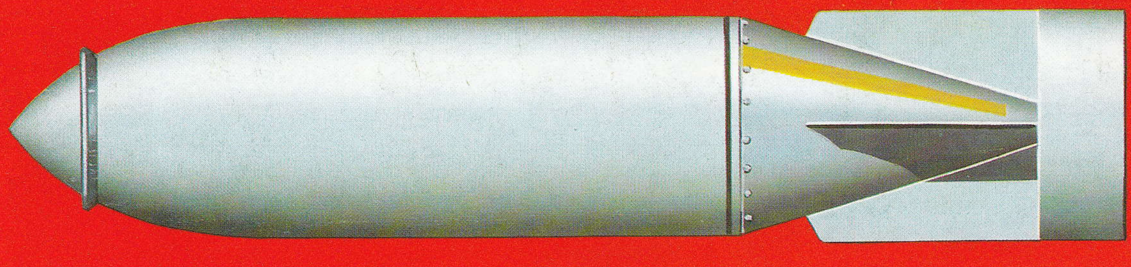

Armed Forces of the World: West Germany (Part 2)

A fully illustrated guide to World War II Air-to-Ground Weapons

WAR MACHINE

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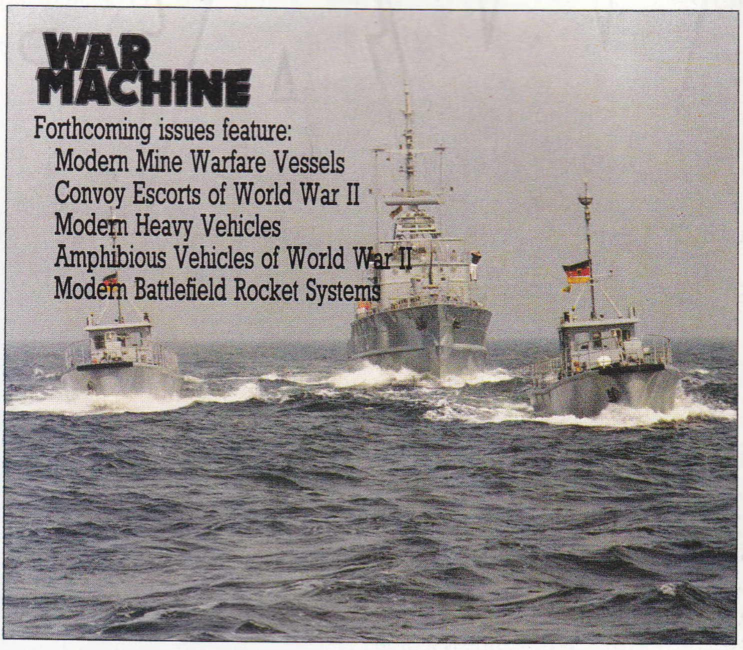

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Cover photograph: Boeing B-17 Flying Fortresses drop a steady rain of bombs on Germany. The US Air Force used a wide variety of air-to-ground weapons during World War II.

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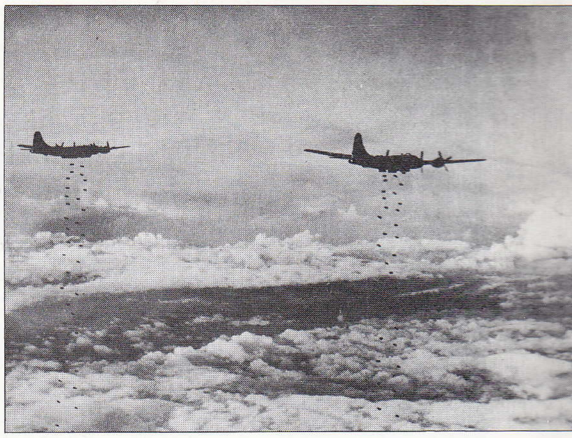
World War II Air-to-Ground Weapons

After World War I it was widely believed that air power would make all other machines of war obsolete and that future conflicts would be settled by huge fleets of bombers. World War II quickly exposed the limitations of air power; daylight bombing could be prevented by aggressive fighter aircraft, and night bombing was wildly inaccurate. But by 1943 weapons and tactics had been developed, particularly by RAF Bomber Command, which made the dreams of the pre-war bomber lobby a horrific reality.



Daylight raids, so strongly advocated before 1939, proved prohibitively expensive for the bombers in the first years of the war. The Americans, however, were determined to bomb by day, and despite the best efforts of the Luftwaffe, German cities were bombed right round the clock.

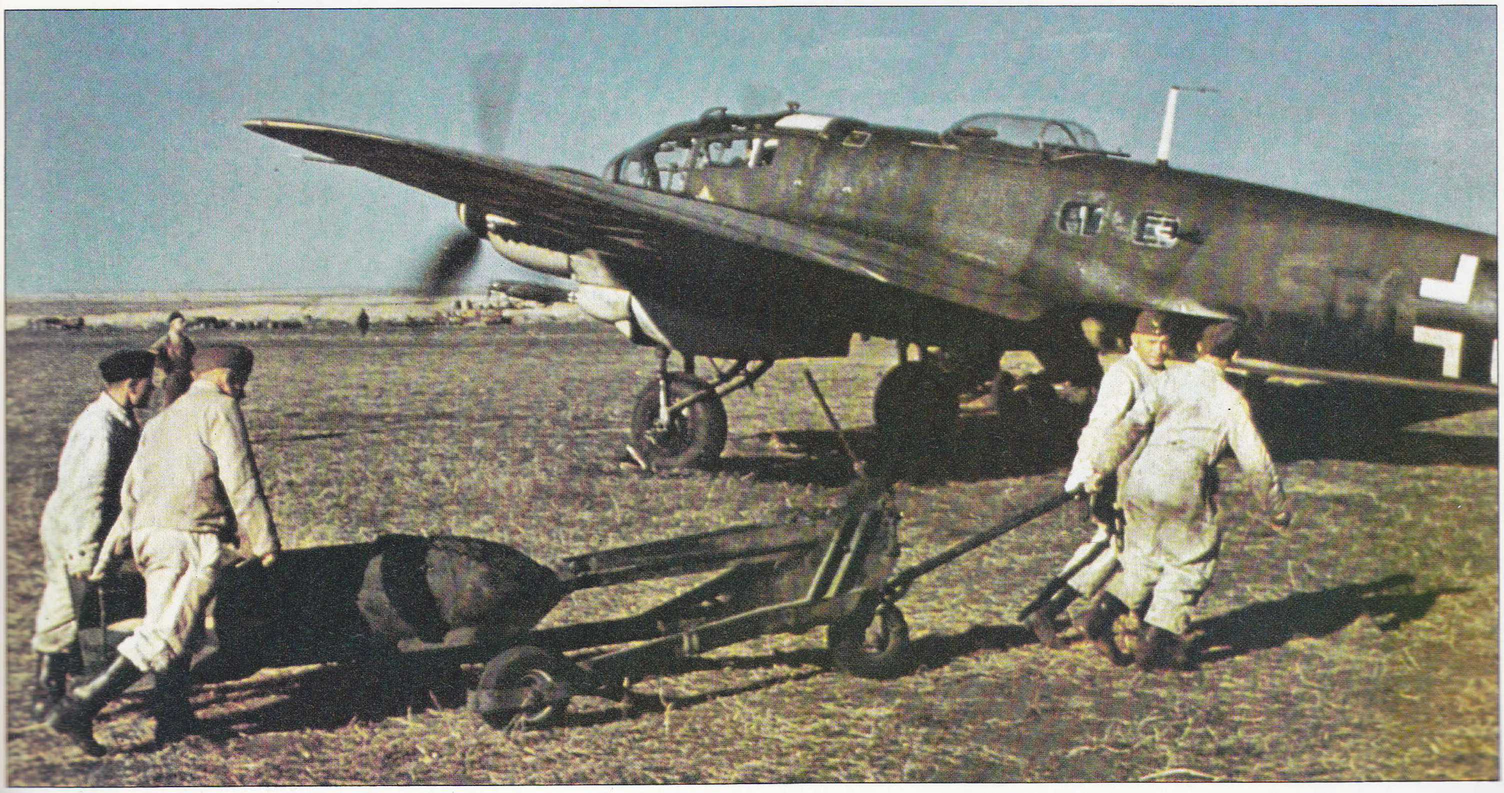
The art of dropping explosives from an aircraft is almost as old as aviation itself, it being recorded that Giulio Gavotti dropped a quartet of picric acid bombs of 1.8 kg (4 lb) on Turkish troops in the Libyan desert in 1911. Seven years later the art was developing into a science with the design of such specialist machines as the Sopwith Salamander.

That new targets would have to include armoured vehicles became clear during the 'dress rehearsal' of World War II that was the Spanish Civil War, and soon refinements such as the *Dinort* extension rods (on the noses of perhaps the SC 50 bombs delivered by that supreme exponent of the early ground attack, the Junkers Ju 87) became commonplace means of ensuring a maximum blast effect over a wide area.

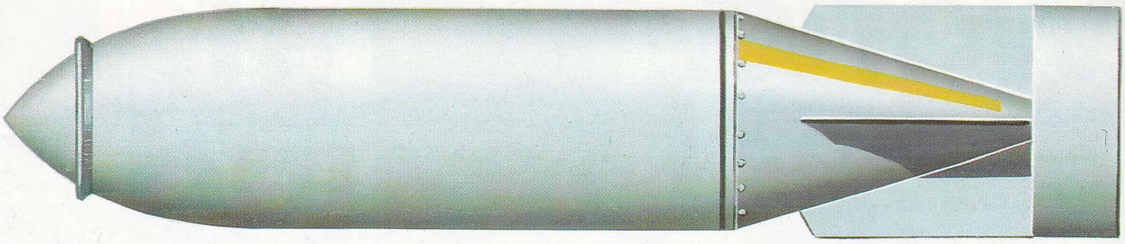
While heavier guns were soon demanded as the thickness of armour on 'hard-skinned' vehicles increased, it was really the re-invention of the rocket as a weapon that moved the science forward.

Also taking on a less hit-and-miss aspect was the manner of dropping conventional free-fall bombs. The early methods of merely destroying everything with huge quantities of high explosive released over a target later gave place to controlled 'carpet bombing', and to the system which was to prove the comparative crudity of earlier methods, namely that of opening up buildings by blowing the roofs off with high explosive and then destroying the unprotected structures with a rain of incendiary bombs. Over and above all these advances, some thoughts were given to increasing the psychological effect of ground attack with screamers on bomb fins to augment the normal whistle, and 'Jericho trumpets' on the legs of diving Stukas.

Luftwaffe ground crew manoeuvre an SC 500 bomb towards a Heinkel He 111. German bombs were colour coded: the thin-walled SC series sported a yellow stripe between the quadrants of the tail cone; thick-walled SD bombs carried a red stripe; and armour-piercing munitions had a blue one.



German standard bombs



The SC 2000 was among the heaviest of air-to-ground weapons used by the Luftwaffe. The number after the letter designation was supposed to be the weight of the weapon in kilograms but it actually weighed 1953 kg (4,306 lb).

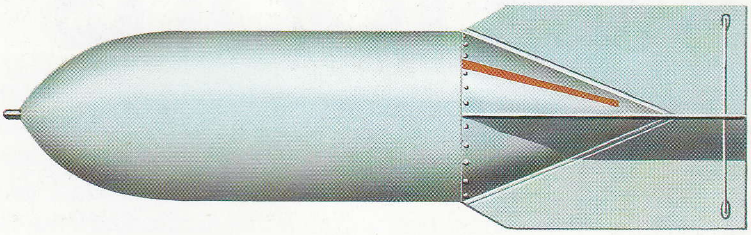
Three categories of standard bomb were in use by the Luftwaffe, all in the general-purpose group designated according to their nature and weight. First of these was the high explosive **SC** (*Sprengbombe Cylindrisch*), a thin-walled type for normal free-fall use; then there was the semi-armour piercing **SD** (*Sprengbombe Dickwändig*), a thick-walled type; and finally there was the armour-piercing **PC** (*Panzersprengbombe Cylindrisch*) with extra thick walls.

Of these, among the most commonly used were the **SC 250** type, the second part of the designation indicating the weight of the explosive in kilogrammes (551 lb), and eight of these or 32 of the **SC 50** or **SD 50** (10 lb) type would make up a typical load for a Heinkel He 111 bomber, and be deposited on target mixed with incendiaries.

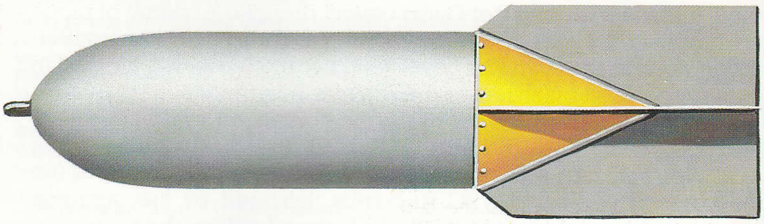
Many of these bombs rapidly acquired names so that while the latest of the GP bombs (the **SD 1700**) for some reason had none, the **SD 1400** became **'Fritz'**, the slightly smaller **SD 1000** being **'Esau'**. Strangely, there was none for the common **SD 500** of which there were two types, one with strengthening bands and trunnion bolts on a differently shaped case. At the other end of the scale the **SC 1000** was **'Herman'** and the **SC 1800** was **'Satan'**.

Carried either on external or internal racks, German bombs were suspended from single 'H' or 'T' lugs (or less commonly a ring bolt), and were colour-coded with a stripe between the quadrants of the tail cone (or the entire cone in the case of small bombs such as the SC 50 etc.) denoting their classification: SC was yellow, SD red and PC blue.

Electrically-charged impact fuses were fitted with charging plungers above the main fuse body with its tumbler switch. Below this lay the flash pellet, Penthrite wax and picric acid to complete the whole, although variations were incorporated such as the Type 17 clockwork delayed action devices or the Type 50 with a trembler switch fuse acting as a booby trap, or the infamous Z.U.S.40 set beneath the normal fuse in such a way that the extraction of one, made 'safe', activated the other concealed beneath it.

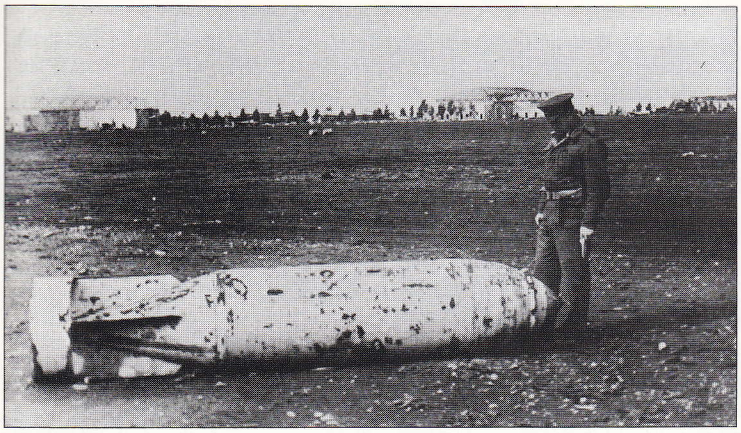


SD 250s were thicker-walled than the SC series to give them limited armour-piercing capability at the cost of a slight reduction in payload.



***Right:** A Heinkel He 111 could carry up to 32 of the SC 50 (110-lb) bombs seen here, although it was common practice to mix a number of incendiaries into the bombload.*

***Below:** A Junkers Ju 88A-5 prepares for take-off, carrying a pair of SC 250 bombs underneath the wings inboard of the engine nacelles. Lacking capacious bomb bays, many German bombers carried the majority of their ordnance on external mountings.*



Specification
SC 2000
Type: high explosive bomb
Weights: 1953.2 kg (4,306 lb)
Dimensions: length 3.44 m (11 ft 3.4 in); diameter 0.661 m (2 ft 2 in)
Filling: Tinalin

Above: This 1800-kg (3,968-lb) German bomb was found at Barce, an air base in Libya, in 1942. The 1800 kg bomb was one of the biggest in general use by the Luftwaffe, and was generally carried by Heinkel He 111s.

Allied forces found these German bombs scattered from a wrecked ammunition train near Taranto. Most of the bombs appear to be of the SC 250 type, which had stiffening stays between the fins, whereas some larger bombs had annular rings.

GERMANY

Ruhrstahl/Kramer X-1 (Fritz X)

The agreed surrender of the Italian fleet to the Allies on 9 September 1943 saw the battleships *Italia* (damaged) and the *Roma* (sunk) as the targets of a new type of air-launched weapon, the **Ruhrstahl/Kramer X-1** (or **Fritz X**). This was a free-fall bomb that could be guided towards its target after release from an altitude of about 6000 m (19,685 ft); by the time it had reached its target perhaps 2.4 km (1.5 miles) distant it had gained a velocity approaching that of sound.

Control was by means of electromagnetically operated spoilers activated in sympathy with radio signals from the aircraft (frequently a Dornier Do 217) that, after releasing the bomb, had its motors throttled back and was taken to a higher altitude so that it was over the target at the moment of impact, the observer having kept track of the missile with the aid of a conventional Lotfe 7 bombsight. Wire-link control using transmission lines some 8 km (4.97 miles) long was later discarded as an economy measure.

Tests were begun in Germany during 1942, later being moved to Italy. Here pneumatic power was experimentally substituted for the electro-magnetic actuation of the spoilers, but variations in temperature created problems so the concept was dropped.

This is all that remained of the 45,000-ton battleship Roma *after two X-1 glide bombs struck her as she steamed to Malta to surrender to the Allies. The first bomb passed through the ship and detonated underneath; the second penetrated the forward magazine, which blew her in half.*

The Allied assault on Italy meant that the Fritz X was pressed into increased use: the cruiser USS *Savannah* was successfully attacked, as were some naval transports, while in the confusion created by a night attack two British cruisers came into collision. Seven days later the battleship HMS *Warspite* was hit by these armour-piercers, so that a tow to Malta was necessary.

About 66 of the bombs were produced each month, far short of the target figure, and about half of these were used during tests conducted during 1943 and into the following year. But the real end to the Fritz X programme was brought about not by production difficulties but by the high loss rate among the bombers equipped to deliver the missile: because of the need for relatively slow speed over the target area, the launch aircraft became particularly vulnerable.

Specification
X-1
Type: free-fall guided bomb
Powerplant: none
Performance: maximum speed 1035 km/h (643 mph)
Weights: round 1570 kg (3,461 lb); explosive 320 kg (705.5 lb)
Dimensions: span (over fins) 1.352 m (4 ft 5.2 in); length 3.262 m (10 ft 8.4 in); fuselage diameter 0.562 m (1 ft 10.1 in)

GERMANY

German unguided missiles

Although ground attack was one of the major roles of the Luftwaffe, this task was generally carried out with conventional aircraft armament, plus either normal free-fall bombs up to the 250-kg (551-lb) capacity, or those of specialist design including the small SD 2 fragmentation ('butterfly') bomb, which was first used on the opening day of the German assault on the Soviet Union. It was, however, this same country that was to influence the Luftwaffe's introduction of rockets as air-to-ground weapons.

The slow advent of these weapons was in part due to the lack of results seemingly achieved by the Soviet 82-mm (3.23-in) rockets, and the importance of such unguided weapons seemed to be further devalued by experience of German field trials. These had taken place during 1942 when Jagdgeschwader 54 had been temporarily equipped for operational tests against targets crossing Lake Ladoga to supply Leningrad. The missiles employed were adapted army-type 210-mm (8.27-in) rockets on launchers under the wings of Messerschmitt Bf 109Fs. Unfortunately these rockets proved almost impossible to aim since their low velocity after release resulted in a sudden drop in their trajectory.

However, although these were discarded, two years later some Focke-Wulf Fw 190s were fitted with an improved rocket variant in October 1944, the first to be fitted to these aircraft. These were **Panzerschreck** missiles of 88-mm (3.46-in) calibre, the design source being originally the infantry 'bazooka'. Each aircraft was fitted to take six of these weapons, and in December the new **Panzerblitz Pb 1** missile (also of 88-mm calibre) was introduced: this packed something like twice the punch of the Panzerschreck, but neither was used on any scale.

Specification
Panzerblitz Pb 1
Type: air-to-ground aircraft-launched rocket
Weight: 6.9 kg (15.21 lb)
Dimensions: length 0.70 m (2 ft 3.6 in); diameter 8.8 cm (3.46 in)

GERMANY

Henschel Hs 293

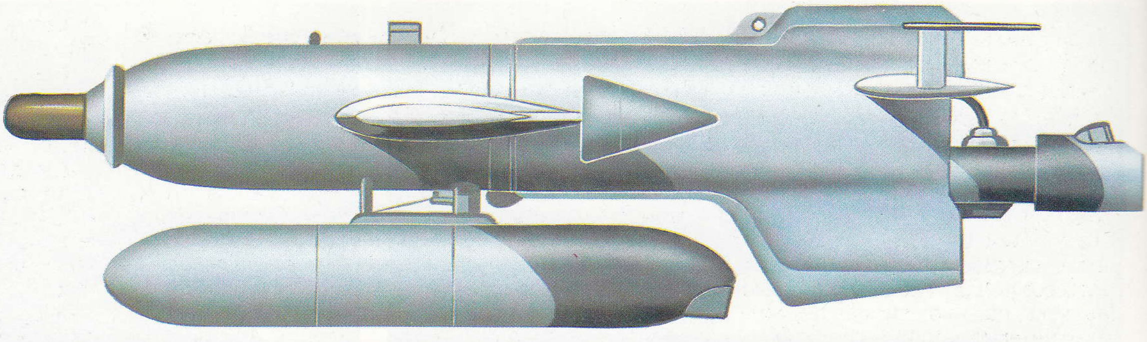
The beginnings of what was to evolve into the **Henschel Hs 293** were laid as early as 1939, and a test model taking the form of a glider was constructed the following year, the ultimate intention being to develop a missile that could be used against shipping under remote control from a launching aircraft.

Although a suitable rocket motor was still not available, development went ahead using a standard SC 500 bomb fitted with wings and tail unit, although no rudder was incorporated, and as time progressed the programme saw the fitting of the first version with a propulsive unit, this taking the form of a liquid rocket (using T-stoff and Z-stoff propellants) slung under the main body. An 18-channel radio system ensured control.

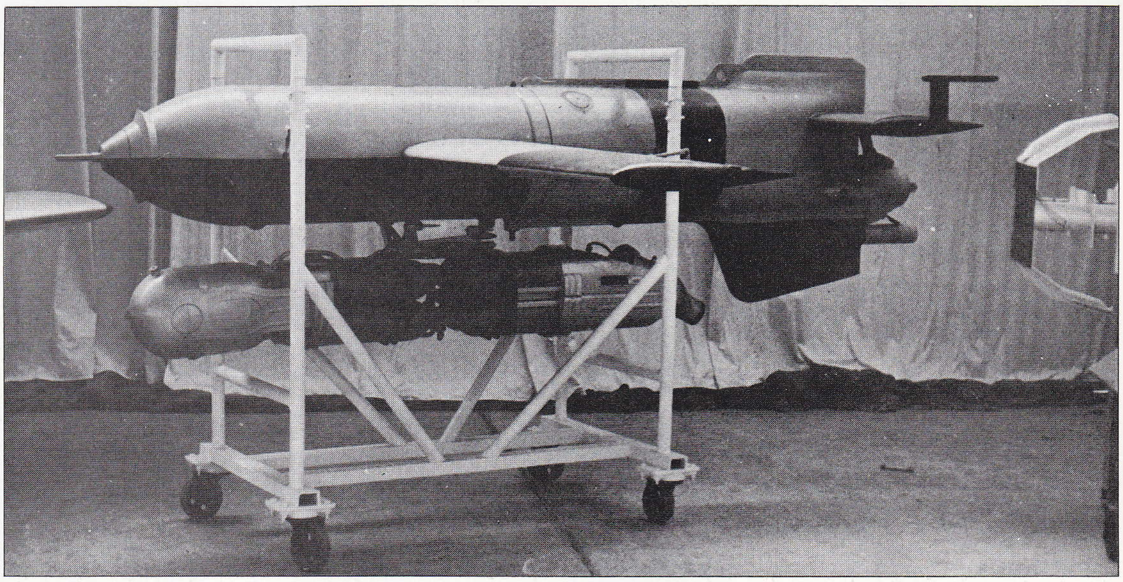
It was anticipated that the missile would be carried into action under a parent aircraft, from which warm air was channelled to prevent the missile from freezing up at the high altitude at which it was released, but at 1400 m (4,595 ft) a maximum of 3 km (5 miles) could be anticipated. Once released the Hs 293 dropped some 90 m (295 ft) before the rocket developed maximum thrust, and the parent aircraft continued to fly a set course parallel with the target, while permitting the bomb-aimer to keep the missile in sight and guide it with the aid of a small control box on which was mounted a miniature control column, keeping in sight the red guidance flare in the tail, the actual flight path being a series of arcs as corrections were received.

The main disadvantage of the Hs 293A was that the launching aircraft had to maintain a steady, level course and evasive action to escape AA fire was impossible. An improved Hs 293D with a television aiming system was planned, but the war ended before it could be constructed.

However, icing was a problem never really overcome and as a consequence further propulsion units were developed. But these were never taken beyond the experimental stage.



The Henschel Hs 293A stand-off guided bomb was dropped from the carrier aircraft on a parallel course to the target on the port side, and radio-guided to the target. A flare in the rear of the bomb gave visible evidence of the missile's position to the aimer.



Above: This Henschel Hs 293 has had its rocket propulsion unit removed to show the internal equipment. The flare unit for visual location of the missile in flight can be seen at the back of the weapon.

Specification

Hs 293

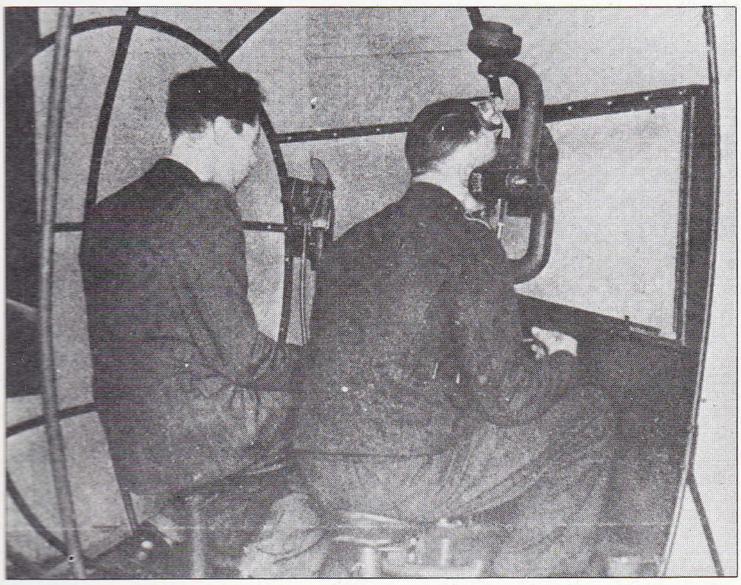
Type: rocket-propelled anti-ship missile

Powerplant: one 600-kg (1,323-lb) thrust Walter 109-507B rocket

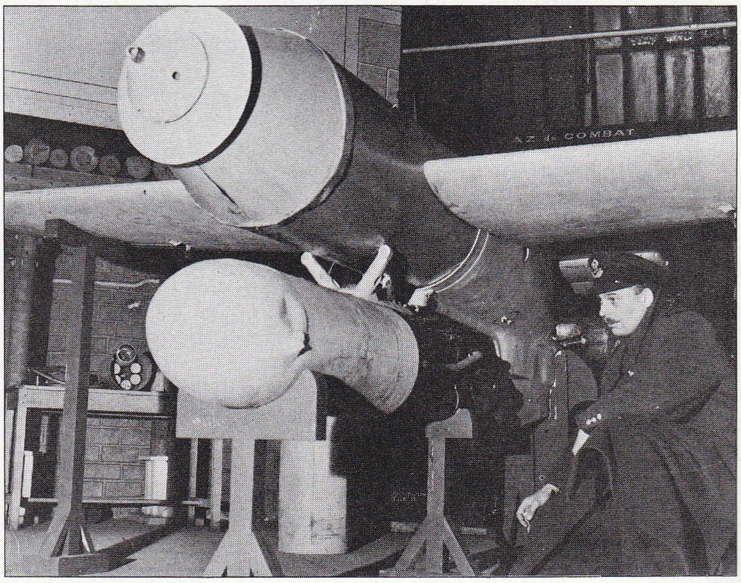
Performance: maximum speed 900 km/h (559 mph)

Weights: round 1045 kg (2,304 lb); explosive 295 kg (650 lb)

Dimensions: span 3.14 m (10 ft 3.6 in); length 3.58 m (11 ft 9 in); fuselage diameter 0.48 m (1 ft 6.9 in); wing area 1.92 m^2 (20.67 sq ft)



Crew members learn to control the Henschel Hs 293 guided bomb in a simulator. The guidance operators always sat on the starboard (right) side of the cabin, and therefore it was always necessary to attack a target from the port side and in the same movement direction.



A Henschel Hs 293A stand-off guided bomb. This example was found near Paris in 1944 by Allied forces. The flat disc around the nose of the bomb prevented deep penetration before exploding.

The Sinking of HMS *Egret*

Attacking ships with conventional bombs is a hazardous business, as the Argentine air force discovered in the Falklands campaign. The Germans were well aware of this before World War II, and in 1943 they launched the first successful attack with a guided missile on an enemy warship. Flying out of range of British anti-aircraft fire, a Dornier Do 217 E-5 guided an Hs 293 missile towards its target.

The introduction of the new type of guided bomb presented problems for the Luftwaffe. Training was the least of these, and each man under instruction was to be allowed experience controlling three actual Henschel Hs 293 launches, but what was lacking was operational experience with the new device; to this end 13. Staffel of KG 100 was dissolved and reformed as an experimental unit in July 1943, the Hs 293A-1 missile in the meantime having been in production since January of the previous year.

The place and time of the little bomb's baptism of fire was naturally in the lap of the god of wars, and the venue for this was as curious as it was unexpected. Kampfgeschwader 100's second *Gruppe* was, in the late summer of 1943, flying from its base at Cognac, and Wednesday 25 August (the day that saw the end of Japanese resistance in New Georgia) found a small British naval force approaching the Bay of Biscay. The role was fairly routine since the ships' duty was to sweep the area for German U-boats, whose increased activity had given rise to the belief that they were using Spanish waters.

As the group of vessels (made up largely of destroyers) neared its rendezvous, it was doing no more than relieve the 40th Escort Group, the relieving vessels being under the command of the senior officer of the 1st Support Group in the sloop HMS *Egret*, of 1,200 tons.

The Germans were alerted by this activity, and it was not long before the Dornier Do 217E-5s of II/KG 100 were in the air, each carrying beneath them examples of the new type of Henschel bomb.

It was not difficult to find the naval force that was the target, and before long the waters of the Bay of Biscay were churned into a liquid inferno as the ships took avoiding action to escape the new robots. This was the type of target against which the Hs 293 was at its most effective, small lightly-protected ships; at a later period, even these would learn the technique of dealing with their threat by means of concentrated close-range fire. However, on this occasion none of the British ships were sunk and the results were inconclusive.

Two days later, Friday 27 August, was another of those days when, true to the epithet that 'war is mostly waiting', the newspapers at home were forced to record in glowing tones the fact that the French diplomatic committee had been recognized by the USSR and Nationalist China. In the Bay of Biscay, by contrast, the day was to prove one of historical action.

Dorniers approach

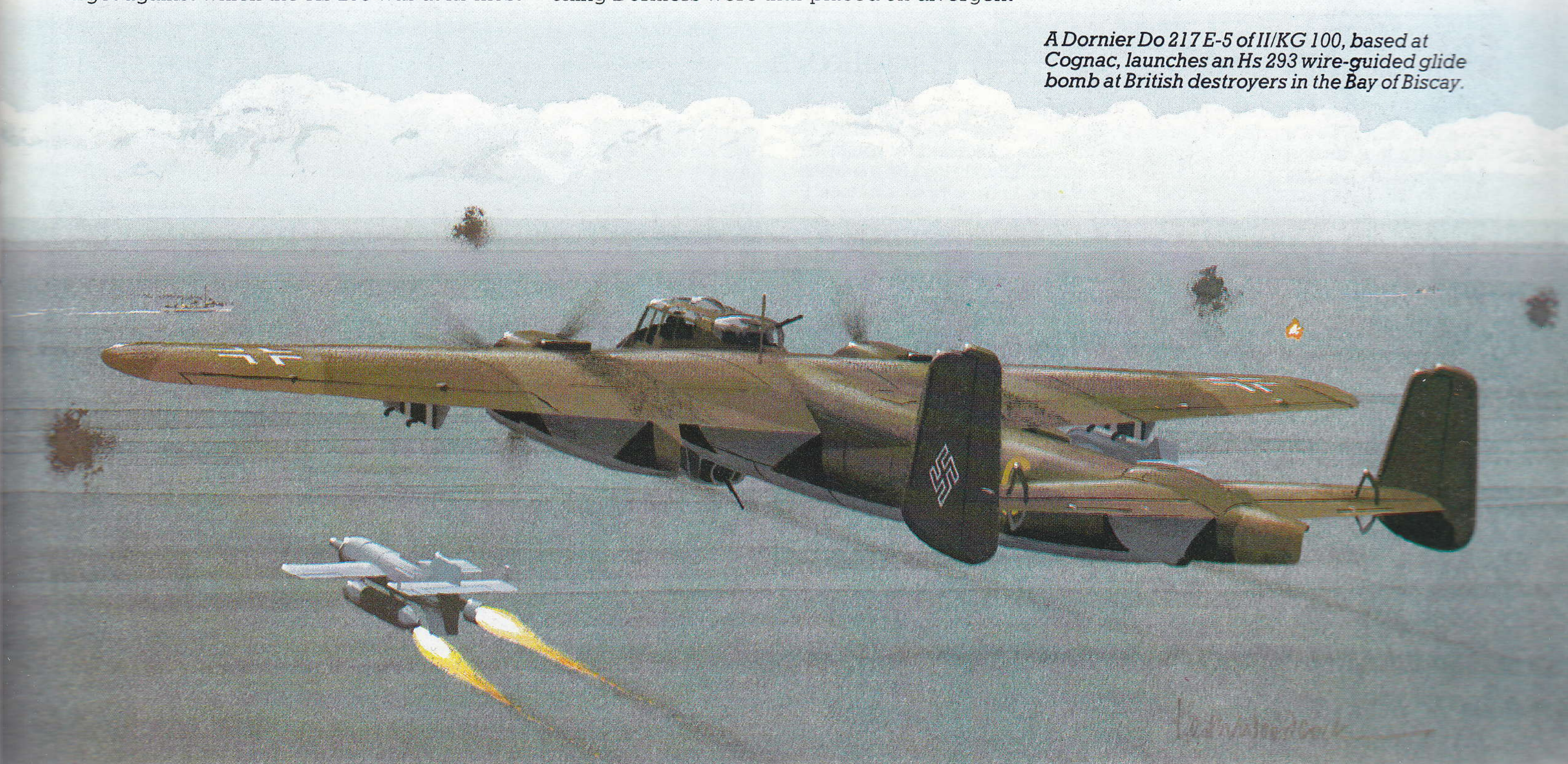
Joined only a few hours earlier by HMS *Grenville* and HMCS *Athabaskan*, the support group began a sweep south of Finisterre, but it was only a short time past mid-day when the sound of aircraft motors seemed to fill the air as the lookouts spotted the approach of 18 Dorniers from II/KG 100. To some of the observers on the ships the manoeuvres of the attackers appeared strange, for they released their missiles and almost at once turned away to starboard, while the little Henschels came away from the mother planes and could be seen to drop some 90 m (300 ft) before the rocket motors developed full thrust and drove them back almost to their original altitude.

One Dornier was seen to turn now, its missile released at a range of almost 18000 m (19,685 yards), and fly parallel to the *Egret*, while in the hail of fire that the defenders put up another was seen to be stalking the *Athabaskan* in the same way. The reason for this was that after about 12 seconds of running the rocket motors of the Henschels cut out, leaving them to execute shallow glides towards their targets, accelerating under gravity. They and the launching Dorniers were thus placed on divergent courses, with the observer sighting the doomed vessel at 90° to the line of flight and thus able to keep both it and the missile under observation while the movements of the former were controlled by means of a miniature control column in his hands, the Henschel being made the more visible by its tail-flare.

Below, the little sloop *Egret* looked like a toy as she twisted and turned to avoid the inevitable, her eight 101.6-mm (4-in) guns no defence against the new weapons, and in not more than 100 seconds both the *Athabaskan* and *Egret* were hit, the latter immediately catching fire and shortly afterwards blowing up with the loss of the 232 ratings aboard, and seven of her officers. T/Sub-Lieutenant T.B. Brotheridge was mentioned in the casualty list published in the middle of the following month as having escaped, wounded, but there was no mention of J.V. Waterhouse DSO, RN, the *Egret*'s acting commander.

Thus passed into history the sloop that was the first victim of the Henschel Hs 293. The other vessels escaped, and in September 1943 II/KG 100 was transferred to Istres, not far from Marseilles, to attack ships in the Mediterranean by night.

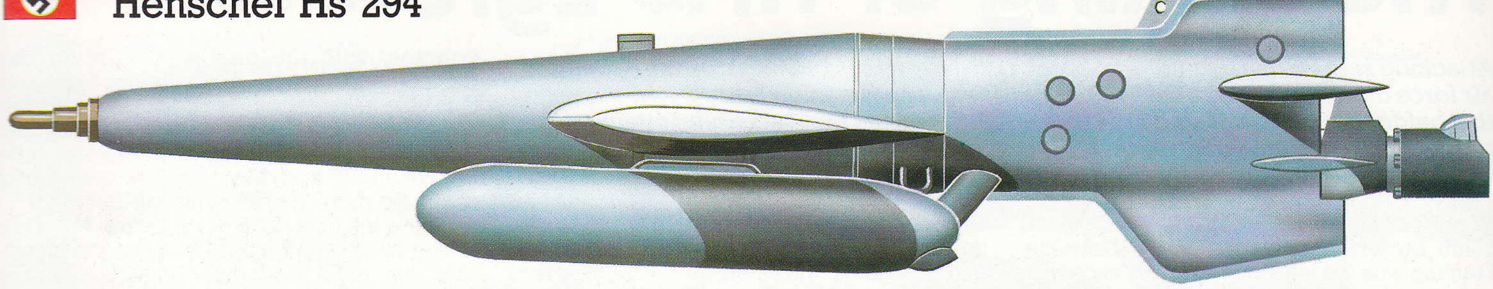
But by a curious coincidence the U-boats that had been the indirect cause of the first successful Henschel 293 action come again into the picture of the missile in the following October; it was in an attempt to stem the rising losses inflicted on these submarines that Hs 293 attacks began to be concentrated on Atlantic convoys, it being to this end that the Heinkel He 177A-5s of II/KG 40 with Hs 293 missiles were sent to Bordeaux-Mérignac. Their first major attack was carried out with 20 machines in bad weather on Sunday 21 November. The resultant action was as a consequence something of a failure, II/KG 40 being soon afterwards moved again, this time to operations over the Mediterranean, leaving the work over the Atlantic to the modified Focke-Wulf 200 Condors of III/KG 40. Sloops, transports and escort vessels apart, it is on record that a total of five destroyers were sunk by the Hs 293A.



A Dornier Do 217 E-5 of II/KG 100, based at Cognac, launches an Hs 293 wire-guided glide bomb at British destroyers in the Bay of Biscay.

GERMANY

Henschel Hs 294



The Henschel Hs 294A was too late to enter service in World War II. It was designed to attack heavily-armoured ships below the waterline. The wings and rear fuselage were designed to break away from the warhead for underwater stability, and it had an upward movement in water.

The use of the Henschel Hs 293 against shipping had proved to be not without its problems since entry into the water for a strike at the lower hull had generally deflected the missile's course. In order to discover a means of correcting this, a series of tests was carried out with Hs 293 fuselages carrying modified noses, these for the most part being long and slender; 1943 saw these trial models evolved into a larger weapon that was sufficiently different to be redesignated **Henschel Hs 294**.

There were two basic variants of this weapon, the **Hs 294B** having wire-link control. This shared with its radio-controlled companion model, the **Hs 294A**, an ability to lessen the water-entry deflection by means of an ingenious arrangement. This took the form of fitting the wings and rear fuselage with weak points that allowed these two parts to be shed on entry, while the fitting of a ridge on the upper part of the nose was sufficient to guide the missile upwards towards the hull of the target vessel, the residual momentum being enough to propel the bomb on the final part of its journey.

The new missile had sufficient flexibility of operation for its entry into the water to vary between 15° and 30°, and the charge in the warhead was fired by means of naval torpedo proximity fuses, although the design was capable of being fitted with contact fuses which, if employed, would have resulted in the missile being introduced into service much earlier. As the proposed production rate was scheduled to be in the region of 50 per month, an earlier service debut might have posed a serious threat to Allied shipping.

A later version, paving the way for the **Hs 294D**, was in process of being fitted with television cameras in the leading edge of the starboard rocket housing when the war ended, and there were also plans to produce a later variant propelled by only a single unit of increased thrust, while a further version (of which a small number was built) differed in having wing-fitted spoiler controls.

Specification

Hs 294

Type: rocket-propelled anti-ship missile

Powerplant: two 1300-kg (2,866-lb) thrust Walter 109-507D rockets

Performance: maximum speed 860 km/h (534 mph)

Weights: round 2170 kg (4,784 lb); explosive 656 kg (1,446 lb)

Dimensions: span 4.025 m (13 ft 2.5 in); length 6.12 m (20 ft 0.9 in); fuselage diameter 0.65 m (2 ft 1.6 in); wing area 5.3 m^2 (57.05 sq ft)

GERMANY

Blohm und Voss Bv 143

The limitations of conventional air-launched torpedoes caused the Luftwaffe to cast around for some method of extending the type's range, and the answer seemed to lie in the development of a missile which was capable of flight before entering the water, where it would proceed with the aid of its own propulsion unit.

The body of the **Blohm und Voss Bv 143** was shaped much like a conventional torpedo but with an improved aerodynamic profile, and added to this were wings of low aspect ratio together with a cruciform tail with the horizontal members set well ahead of the fins and rudders, the control surfaces being actuated via a gyroscope. Ailerons were not inset but of the auxiliary wing pattern, and set below the body (at roughly the centre of gravity) was an articulated feeler arm.

This arm did not come into play until the missile had completed its flat glide approach to the target after release from the parent aircraft, but at an altitude of some 2 m (6 ft 7 in) from the surface of the water. Here the design differed from the original concept since the torpedo did not enter the ocean but instead continued at the aforesaid low altitude towards its target, the flight profile now having flattened out and the missile being driven by a liquid-propellant rocket motor, actuated by the arm on contact with the waves. The resultant run was of only 40 seconds duration as the thrust became spent; the motor was powered by petrol and T-Stoff (hydrogen peroxide), the combustion being rendered more complete by the decomposition of the T-Stoff by Z-Stoff. Hydrazine hydrate initiated the reaction of the propellants.

Tests conducted during 1943 using four Bv 143s proved that there was not enough time for the alteration of the flight-path from descending glide to level, and pending the development of an aneroid timer to replace the actuating arm the project was dropped. Except for those involved in trials of other weapons, no further Bv 143s flew.

Specification

Bv 143

Type: rocket-propelled aerial torpedo

Powerplant: one liquid-propellant Blohm und Voss ATO rocket of 700 kg (1,543 lb) thrust

Performance: maximum speed 415 km/h (258 mph)

Weights: round 1055 kg (2,326 lb); explosive 180 kg (397 lb)

Dimensions: span 3.13 m (10 ft 3.2 in); length 5.98 m (19 ft 7.4 in); fuselage diameter 0.58 m (1 ft 10.8 in); wing area 2.45 m^2 (26.37 sq ft)

GERMANY

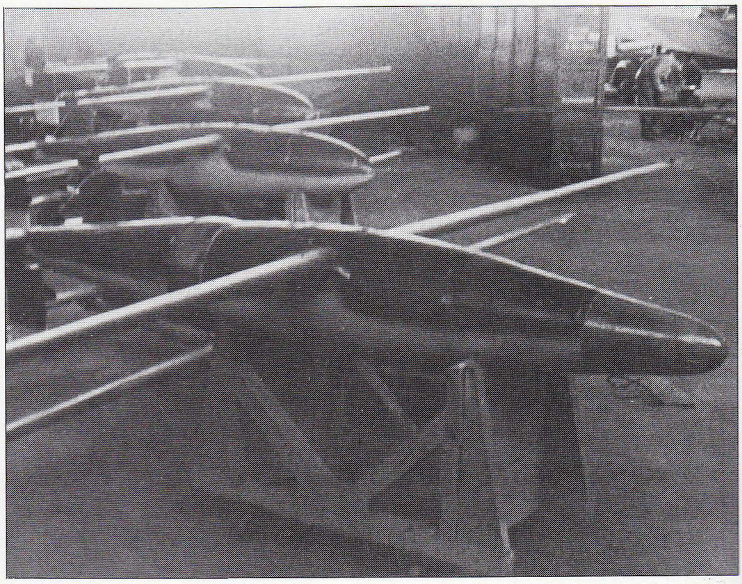
Blohm und Voss Bv 246 Hagelkorn

The **Blohm und Voss Bv 246 Hagelkorn** (hailstone) was the recipient of a production order at the end of 1943, when its designation was changed from the former **Bv 226**. It was one of these initial missiles that was exhibited at Farnborough in 1945, when it was described as having its very high aspect ratio wings moulded from concrete and was seen to have, instead of the cruciform tail of the Bv 246B, an empennage on which the fins and rudders took the form of outriggers at the extremities of the tailplane.

Although there was no propulsion unit, the Bv 246 was controlled to its target via a gyroscope and radio signals from the launching aircraft, the range being some 210 km (130.5 miles) if the bomb was launched at a great enough altitude. Although a shorter-range version (the **Bv 246A**) was designed it was not produced, the designation of the operational version being **Bv 246B**.

When the Nazi missile programme was cut back at the beginning of 1944, the Bv 246s which had entered production over the previous eight or so weeks were cancelled, although the time was sufficiently long for a substantial number to have been produced.

With these a test programme was begun during the following summer with a variety of carrier aircraft, all of them launching the conventional high explosive bomb, none of the additional variants designed for use as anti-aircraft and air-to-air missile targets being then in production. However, this programme was abruptly stopped until stocks could be replenished following an Allied raid in the middle months of 1944.

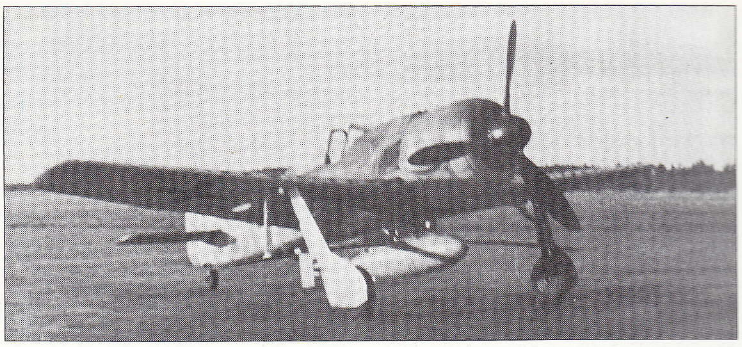


Right: Bv 246 Hagelkorns are seen stored at Karlshagen in the early months of 1944. Note the unusual nose of the missile in the foreground, which probably houses Radieschen *('radish') passive radar homing equipment.*

Further trials were conducted into the early months of 1945 and investigated the possibility of using the weapon against ground transmitters, using their signals as homing sources; this part of the programme was not successfully concluded because of teething troubles with the guidance and control systems.

Specification
Bv 246B
Type: glider bomb intended primarily for anti-shipping use
Powerplant: none
Performance: maximum speed 450 km/h (280 mph)
Weights: round 730 kg (1,609 lb); explosive 435 kg (959 lb)
Dimensions: span 6.41 m (21 ft 0.4 in); length 3.53 m (11 ft 7 in); fuselage diameter 0.54 m (1 ft 9.3 in); wing area 1.47 m^2 (15.82 sq ft)

Focke-Wulf Fw 190 F-8s were used to launch a large number of Bv 246 missiles; the struts beneath the wings bent the bomb's wings down, which held the weapon steady and provided the tension to project it clear of the launch aircraft when released.



JAPAN

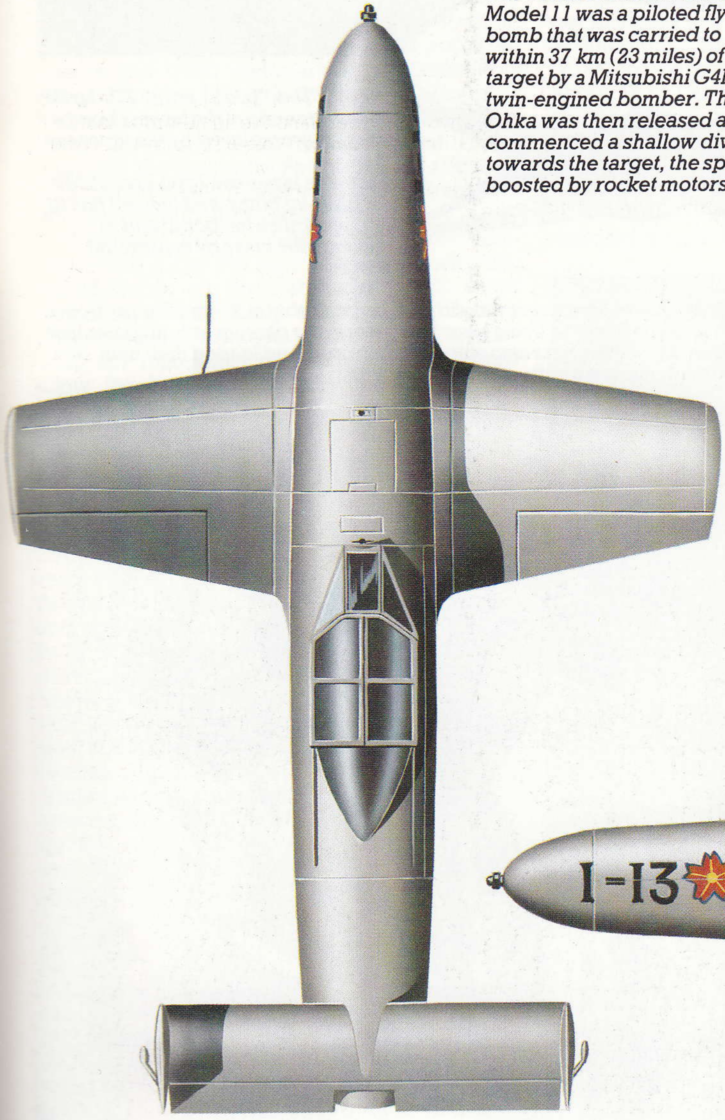
Yokosuka MXY7 Ohka

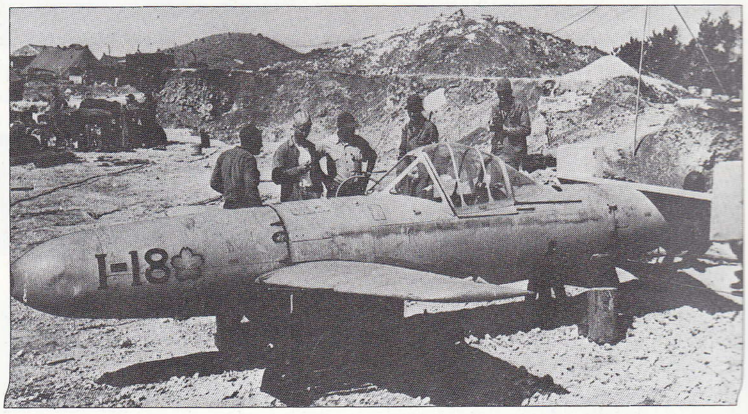
There can be little doubt that the **Yokosuka MXY7 Ohka** (cherry blossom) was one of the most bizarre weapons to come out of World War II, indicating the desperate state of affairs for Japan in 1944 when the *Kamikaze* idea originated as a definite policy of the Imperial Japanese Navy. In consequence, August of that year saw the Naval Research and Development Centre initiate work on the *Marudai* project to design a special machine for manned bomb attacks.

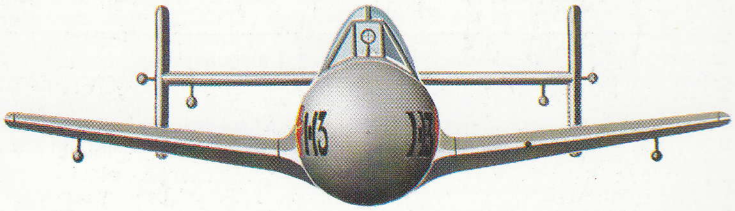
The result of this was the **Navy Suicide Attacker Ohka Model 11**, together with an **Ohka K-1** trainer variant, that was to be air-launched from a modified Mitsubishi G4M2e bomber (Allied codename 'Betty') which would transport the little Yokosuka aeroplane to within about 37 km (23 miles) of the target area, where it would be released and flown to the target by its own pilot in a fast, unpowered glide. During this terminal phase the machine, soon to be known to the Allies as the **Baka** (fool), could prove a difficult target for interception, although this resulted chiefly from its small size rather than its power of evasive action, which was limited. However, the weighty combination of launch aircraft and Ohka was very vulnerable to fighter attack.

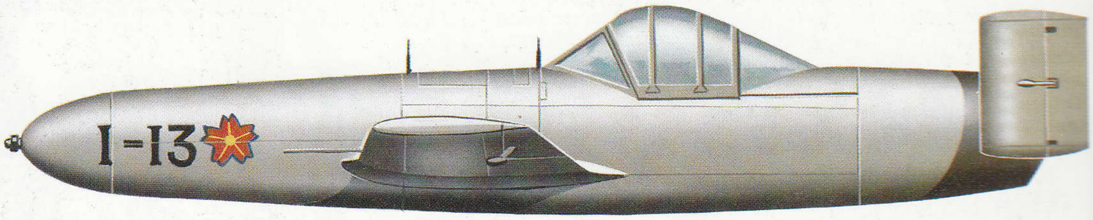
Observers among the US forces in the Pacific, against which all of the operational machines from the 755 produced were directed, noted that it was not until about 4.8 km (3 miles) from the target that the three solid-propellant rockets in the tail were fired, thus accelerating the Ohka to some 927 km/h (576 mph) in a steep dive that would detonate the warhead on the target, killing the pilot in the process. During this final run the bomb was almost unstoppable, so that the only means of dealing with it was to destroy the motherplanes before their loads could be released.

The Yokosuka MXY7 Ohka Model 11 was a piloted flying-bomb that was carried to within 37 km (23 miles) of the target by a Mitsubishi G4M2e twin-engined bomber. The Ohka was then released and commenced a shallow dive towards the target, the speed boosted by rocket motors.





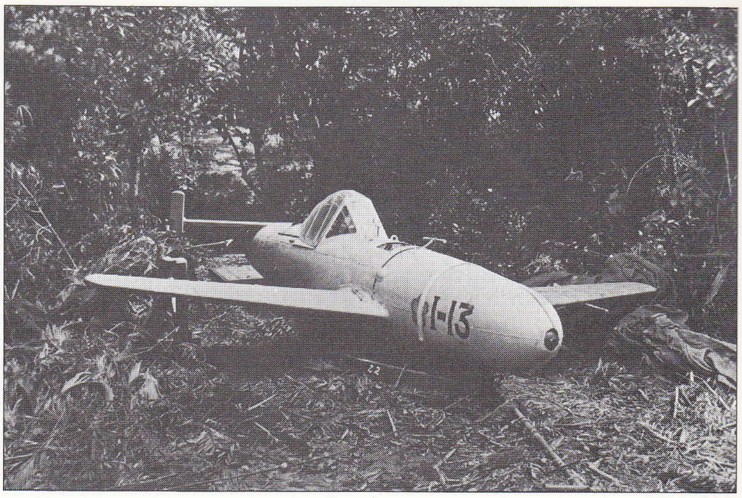




The Japanese conducted considerable research into guided missiles, but none reached operational status. With the Okha they bypassed the complex business of designing a guidance system by recruiting suicide pilots to fly a jet-boosted glide bomb on to the target.

Yokosuka MXY7 Ohka (continued)

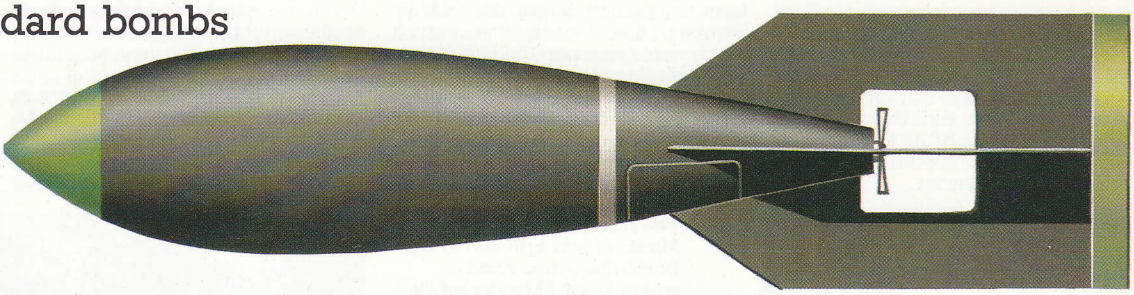
About 50 slightly smaller **Ohka Model 22** aircraft (with a reduced 600-kg/1,323-lb warhead and a gas turbine engine, and designed to be carried by Yokosuka P1Y1 Ginga bombers) proved a failure as they were underpowered, and the jet-powered **Ohka Model 33** (with the original-capacity warhead and designed to be transported by the Nakajima G8N1 Renzan bomber) was not completed by the end of the war. The jet-powered **Ohka Model 43A** and **Ohka Model 43B** (the former with folding and the latter with fixed wings) remained no more than projects; an interesting feature of the Model 43B was the facility for the pilot to jettison the wingtips during the final dive to increase impact speed.


The Ohka Model 11 piloted flying bomb's shallow dive speed was boosted by three solid fuel rockets. The Ohka Model 22 was a longer-ranged version powered by a Tsu-II gas-turbine engine.

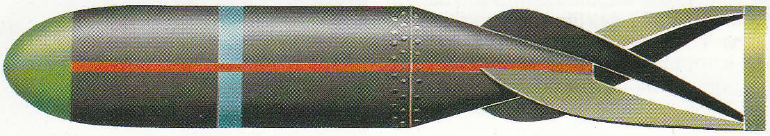
Specification
Ohka Model 11
Type: rocket-propelled suicide explosive missile
Powerplant: three Type 4 Mk 1 Model 20 solid-propellant rockets providing a combined thrust of 800 kg (1,764 lb)
Performance: maximum speed 649 km/h (403 mph) at 3500 m (11,485 ft); dive velocity 927 km/h (576 mph); range 37 km (23 miles)
Weights: maximum take-off 2140 kg (4,718 lb); explosive 1200 kg (2,646 lb)
Dimensions: span 5.12 m (16 ft 9.6 in); length 6.066 m (19 ft 10.8 in); height 1.16 m (3 ft 9.7 in); wing area 6.0 m^2 (64.59 sq ft)

JAPAN

Japanese standard bombs



Above: The Type 99 no. 80 750-kg GP bomb was one of the largest bombs regularly employed by the Japanese.



Left: The Japanese Type 2 no. 25 Mk 111 250-kg bomb had twisted fins to spin-stabilize the bomb and to activate the fuses by centrifugal force.

Ranging from comparatively simple bomb containers capable of taking 30 bombs weighing 0.735 kg (1.6 lb), each albeit for anti-aircraft work, via the larger ones capable of scattering no less than 76 such bomblets to the 800-kg (1,763.7-lb) general-purpose high explosive naval bomb, Japan possessed a good range of air-to-ground missiles in World War II. Smallest of these was the 15-kg (33.07-lb) anti-personnel type with a 10.16-cm (4-in) diameter body measuring only 64 cm (25.2 in) in length.

In the majority of Japanese bombs, fuses were carried in the nose, and it was only on the introduction of the 50-kg (110.23-lb) HE bomb that both nose and tail fuses were employed, although this combination is usually associated with the 250-kg (551.15-lb) high explosive bomb, of which there were two variants.

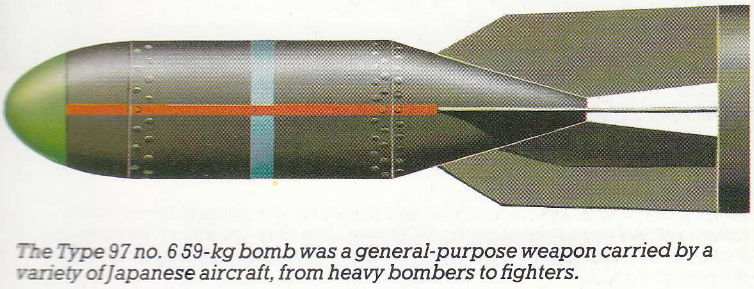
Construction of Japanese bombs followed conventional lines with plain fins lacking a ring, and prominently-riveted sheet metal was frequently employed. Forged steel was, however, used for the body of the 800-kg (1,763.7-lb) armour-piercing bomb, an impressive naval weapon with a pair of B-2(b) tail fuses. Filling was Trinitro Anisol with an aluminium plug in the forward end of the cavity, deep in the steel body, to prevent the filling taking too great a shock on striking the target; the single-piece machined-steel body had eight recesses in the nose for the fixing of windshields if the bomb was adapted as a projectile.

The most widely used Japanese general-purpose bomb was the naval 250-kg type and its army equivalent. There were two versions of the naval weapon, the later model being slightly larger with thicker walls and having a continuous welded/spot-welded nose, although the tail cone was still fastened by rivets. The army favoured screwed steel bodies and nose, with a welded tail cone.

The Japanese armoury included a contemporary of the German 'oil bomb', used by the navy. This contained a central thermite core surrounded by a mixture of kerosene, petrol and alchohol-soap; alternatively rubber pie-shaped pellets impregnated with iron and aluminium were packed round the explosive in its central tube to act as a bursting and scattering charge.

Specification
250-kg GP
Type: high explosive general-purpose bomb
Weight: 250 kg (551.15 lb)
Dimensions: length 1.937 m (6 ft 4.3 in); diameter 30.0 cm (11.8 in)
Filling: preformed picric

Below: Japanese armourers unload bombs, probably of 50-kg GP type, from a truck. Judging from the flying gear being worn, the photograph suggests that the flying crew members also acted as armourers and loaded their own bombs into their aircraft.



The Type 97 no. 6 59-kg bomb was a general-purpose weapon carried by a variety of Japanese aircraft, from heavy bombers to fighters.

Operation 'Gomorrah'

After nearly four years of war, RAF Bomber Command had grown into a force of enormous, if unselective, power. The difficulty of attacking pinpoint targets had led the bombers to turn their attention to the big cities of Germany, and in July 1943 it was decided to direct their full strength against the port of Hamburg.

In the most devastating series of raids up to that time launched by bombers, Air Chief Marshal Sir Arthur Harris, Commander-in-Chief of RAF Bomber Command, set out on the night of 24/25 July 1943 to give a demonstration of just what could be achieved by the systematic application of what were, by the standards of the time, sophisticated weapons, equipment and tactics. The operation, brutally and appropriately codenamed 'Gomorrah', involved the despatch of 347 Avro Lancasters, 246 Handley Page Halifaxes, 125 Short Stirlings and 73 Vickers Wellingtons against Germany's second-largest city, the ancient Hanseatic port of Hamburg with its population of 1.5 million citizens.

Such was the size of the target (an 'area target' as distinct from a specific objective within the city) that it was acknowledged from the outset that several raids, carried out in a short period, would be necessary to accomplish the most widespread devastation. The strategic choice of Hamburg as the target was made on account of its concentration of war industries, not least of which was the huge Blohm und Voss shipyard which contributed 45 per cent of Germany's total U-boat construction programme. Among the city's 3,000 industrial plants and 5,000 commercial establishments were Theodor Zeise, a large manufacturer of marine screws, the Rhenania Ossag distillation plant, the Europäische Tanklager und Transport AG, the Deutsche Petroleum AG refinery, Ernst Schliemann's plant at Wilhelmsburg and the huge Neuhoff power station.

Tactically, being located on the broad estuary of the Elbe, the port would be easily distinguishable on the Pathfinders' H2S radar screens, considerably assisting in effective marking concentration; moreover the modest 1529-km (950-mile) out/back journey would allow the bombers to carry their maximum bombloads.

'Window'

The bombers would also carry a new weapon in the war of the ether: millions of tin-foil strips in bundles which, codenamed 'Window' and cut to half the wavelength of enemy radar, would when dropped effectively blanket and confuse the German night-fighters' and ground defences' radar displays. Hamburg had been previously raided on 98 occasions and the extensive defences had claimed heavy casualties among RAF aircrews and aircraft. By employing a large but compact bomber stream, each of whose bombers would discharge a bundle of 'Window' strips every minute after approaching the German coast, it was hoped to avoid catastrophic losses from the 54 heavy flak batteries round Hamburg, and from the 172 night-fighters known to be deployed in northern Germany.

The first raid started to take-off from bases in England at about 22.00 and an hour later, led by the pathfinders of No. 8 Group, 746 bombers (45 had aborted) in a 322-km (200-mile) stream set course for the mouth of the Elbe. Shortly before crossing the German coast the 'Window'-dropping started; one moment the Germans had been following the approach of the raid on their coastal radar, the next, their displays were covered by blossoming clouds of new signals which effectively obliterated the scopes.

Shortly after midnight the flak crews were alerted, only to find their gun and searchlight radars apparently useless. Night-fighter crews, intent on stalking the bombers from astern, had to break away as the drifting foil gave all the indications that the bombers had suddenly turned towards them. Dead on schedule at 01.57 the first yellow illuminators were released by the leading pathfinders, followed by lines of red 250-lb (113-kg) target indicators.

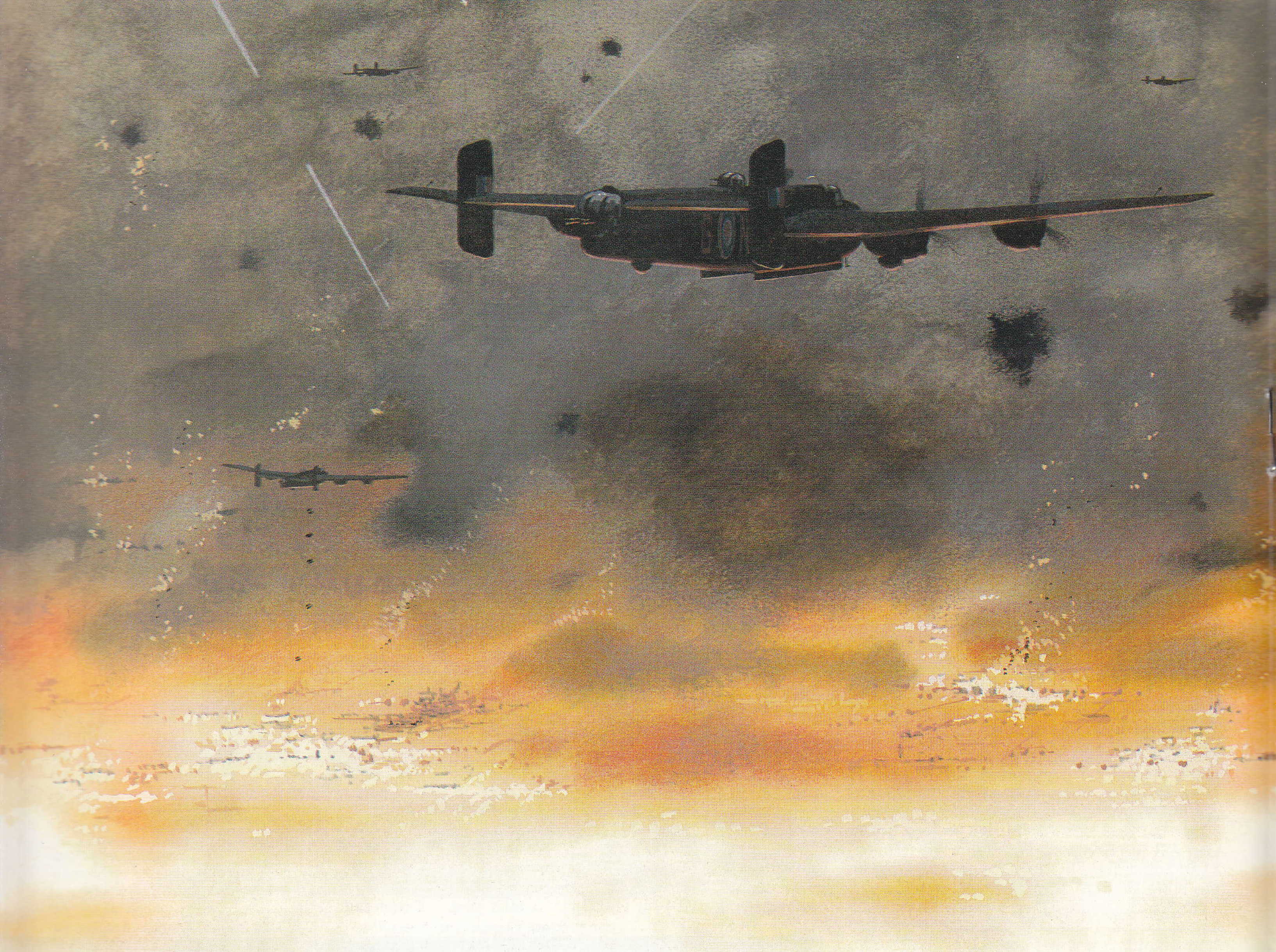
Devastating fire

For three weeks Hamburg had been enjoying hot, dry weather, with no more than 43 mm (1.7 in) of rain; many of the large static water tanks were half empty, and everywhere was tinder dry. Added to this, a large area of the city consisted of ancient buildings constructed of timber. As the leading Lancasters and Stirlings unloaded huge numbers of incendiaries and fires sprang up over a wide area, the city's numerous fire-fighting teams started out to tackle the minor blazes. Then came the Wellingtons, each carrying a single 907-kg (2,000-lb) parachute mines fused to explode about 15 m (50 ft) above the ground and designed for maximum blast effect which knocked down large buildings and blocked the streets with rubble. Finally the Halifaxes and more Lancasters unloaded a mix of 3629-kg (8,000-lb), 1814-kg (4,000-lb) 'blockbusters' and delayed-action 454-kg (1,000-lb) bombs plus incendiary bombs, deliberately intended to collapse large buildings, destroy water and gas mains and trap the fire services in blocked streets. Although a total of 22 of the big 3629-kg bombs was dropped, all of which appear to have exploded causing large areas of desolation, more than two-thirds of the bomb tonnage of 2,396 dropped that night comprised incendiaries.

Devastation was greatest in the suburbs of Altona, Einsbüttel and Hoheluft, and in the city centre; the Police Presidency was gutted, the Air Raid Precaution control room engulfed by fire, and many other vital civil defence operations centres destroyed or damaged. Gas, water, electricity and telephone services were severed at countless points and more than 4,000 key personnel in the city's emergency services were killed or seriously injured. To add to the confusion, long-delay fuses had been fitted to a high proportion of the 454-kg bombs, which thus continued to detonate some hours after the last bombers had departed, frequently erupting to bring buildings crashing down on the rescue workers.

The surprise and disruption caused by the use of 'Window' wrecked the defences of Hamburg no less than the bombing had devastated the ancient city itself; the searchlight and gun radars had been rendered impotent, and the raiders had escaped lightly; 12 bombers (four Lancasters, four Halifaxes, three Stirlings and one Wellington) were lost, the majority of them having strayed from the protection afforded by the bomber stream's 'Window' clouds to be

Boeing B-17 Flying Fortresses of the 323rd Bombardment Squadron, 91st Bombardment Group, US 8th Air Force. The US bombers attacked Hamburg by day on 25 July after the city had been pounded throughout the night by RAF Bomber Command.



On the night of 27 July 1943 the RAF returned and rained incendiaries on to the tinder-dry city. The fire services had already been crippled in earlier raids, and nothing could stop the firestorm which developed. At the heart of the inferno it reached 1000°C, attracting gale-force winds which sucked anything and anyone into the flames.

shot down by night fighters. Compared with a norm of 5 per cent losses, the loss rate of 1.5 per cent in this first big raid on Hamburg represented a saving of 26 bombers, attributable simply to the dropping of some 40 tons of metal foil strips.

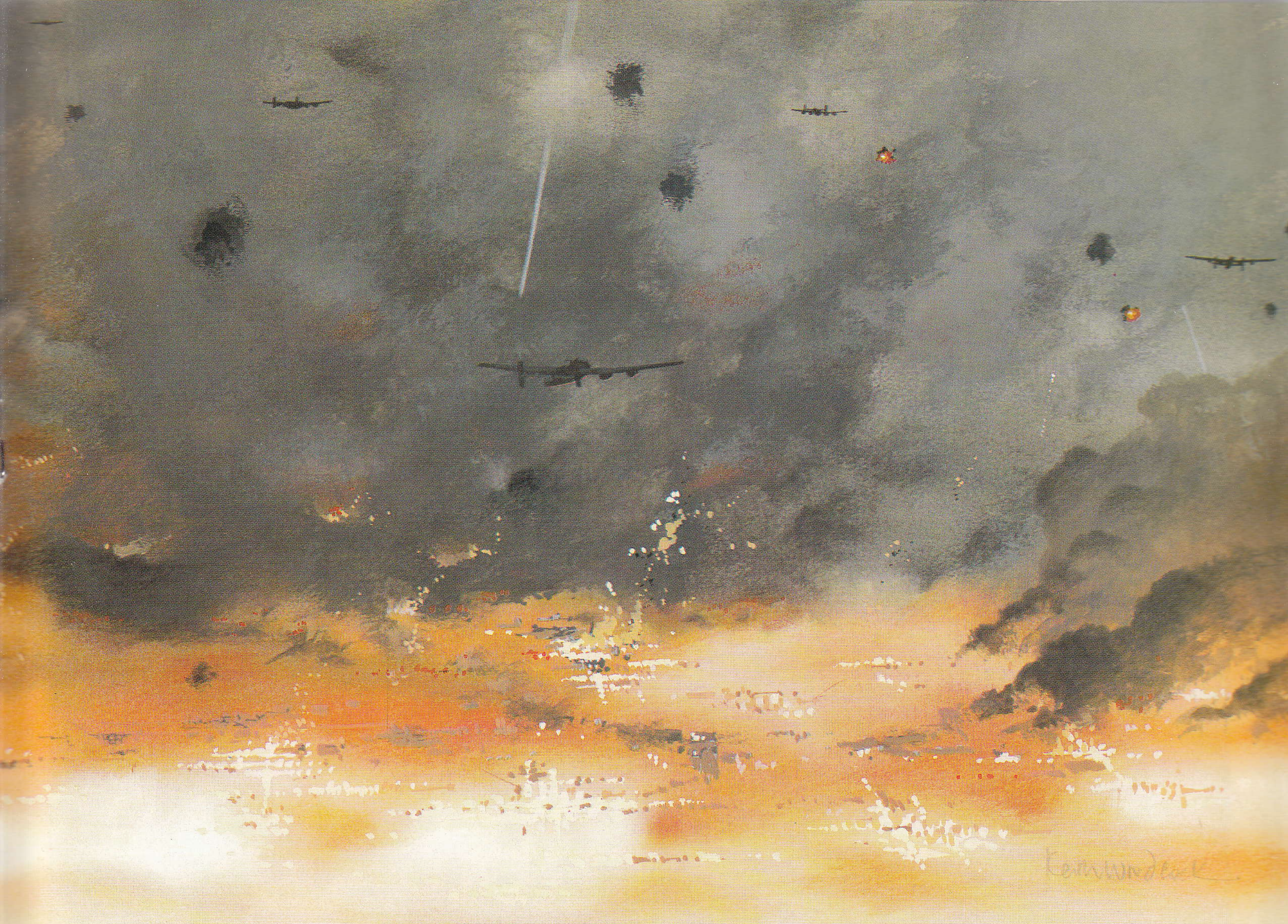
As daylight came to the stricken city on 25 July, a vast pall of smoke and dust obliterated the sun as the dazed inhabitants struggled to release the trapped victims in cellars and shelters, and isolated fires were left to burn themselves out. On that day 68 heavy bombers of the US 8th Air Force carried out a relatively light raid against the dock area and the district of Wilhelmsburg, where the plant of Ernst Schliemann was hit and damaged. On 26 July another American raid by 53 bombers severely damaged the Neuhoff power station. The bombloads dropped during these daylight attacks consisted almost entirely of 227-kg (500-lb) and 454-kg HE bombs (particularly effective against large brick structures and wharf facilities) and once more delayed-action fuses wrought carnage among the rescue workers.

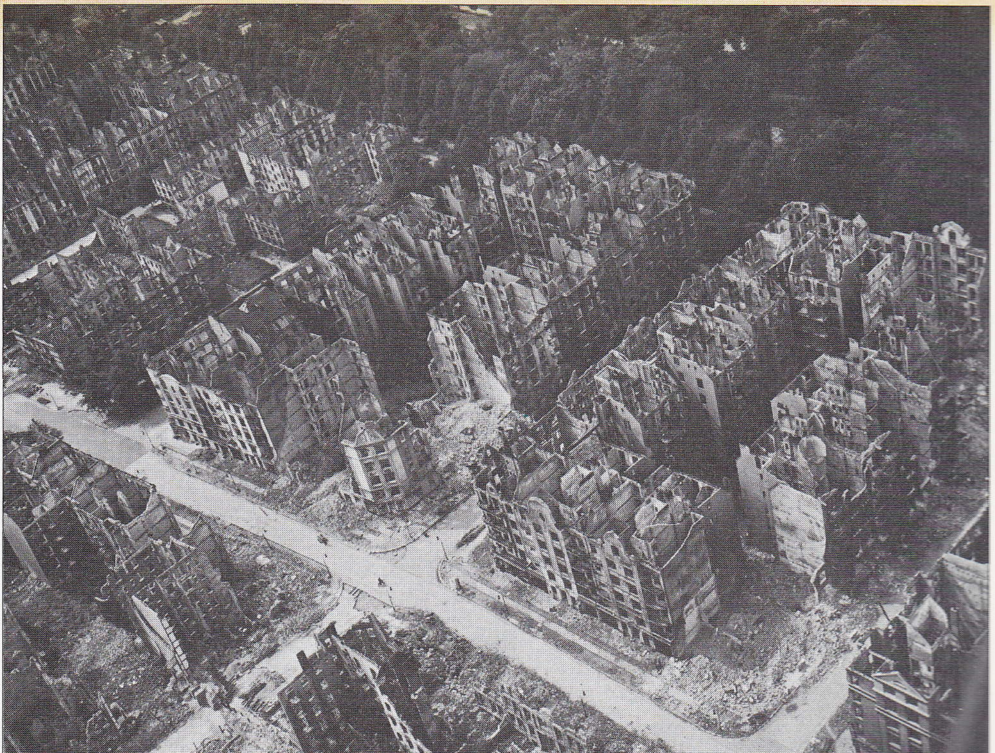
Meanwhile the Reich Defence Commissioner had issued a directive for the voluntary evacuation of civilians from the devastated city, and more than 250,000 civilians had fled, many to pitch camps in the surrounding countryside. On the night of 27/28 July Bomber Command returned once more as 722 out of 739 bombers despatched unloaded 2,417 tons of bombs, well over half this weight composed of incendiaries. The bomber stream flew across the eastern half of the city from north to south, engulfing the districts of Borgfelde, Hammerbrook and Hohenfelde. Within 30 minutes the congested dock area, comprising 20.7 km^2 (8 sq miles) of narrow streets and warehouses, was transformed into a lake of fire which superheated the air to a temperature of 1000°C (1,832°F); this monster conflagration, demanding oxygen, created a terrifying suction from its perimeter 'so that the air stormed through the streets with immense force, bearing upon it sparks, timber and roof beams, and thus spreading the fire still further and further till it became a typhoon such as had never before been witnessed, and against which all human resistance was powerless'. Thus ran the subsequent report to Hitler by Hamburg's Air Protection Leader, General-major H. Kehrl. The man-made winds of 240 km/h (150 mph) tossed human beings like so much chaff into the flames; large trees were uprooted and reduced to charcoal in seconds; citizens strove to avoid oxygen starvation in their shelters by emerging into the holocaust, only to be driven back by the rain of high explosive. Hundreds upon hundreds leapt into the canals where they remained relatively safe from incineration. This fire-storm phenomenon, for which Hamburg was to gain a terrifying immortality, laid to ashes an area of 19770 hectares (6,000 acres). As dawn approached, to the accompaniment of exploding delayed-action bombs and the full extent of the horror became apparent, Gauleiter Kaufmann appealed to all remaining civilians to leave Hamburg: almost 1 million people needed no second bidding and stumbled to the safety of the open countryside beyond the city's limits.

The bombers return

Two nights later the bombers returned, when on the night of 29/30 July 726 Lancasters, Halifaxes and Stirlings dropped 2,382 tons of bombs, scarcely requiring the services of pathfinders so bright were the fires still raging below. With methodical precision the suburb of Barmbeck was deluged with incendiaries and once more a fire-typhoon erupted. By now, with more than 70 per cent of the city's fire-fighting personnel dead or injured, and almost 80 per cent of the civil defence vehicles immobile, the city was powerless to prevent further destruction. Some 28,000 personnel of the military labour corps had been drafted in to demolish dangerous and tottering buildings, and to assist in rescuing and evacuating the tens of thousands of injured.

One final attack was launched on the night of





2/3 August when 762 heavy bombers set out for Hamburg. However, as if the Fates decreed that Armageddon should not befall the city, severe storms persisted all the way across the North Sea and 'only' 442 aircraft attacked, dropping 1,426 tons of bombs. To the terror of fire and explosives were added the crash of natural thunder and the flash of lightning; not even the deluge of rain could quench the inferno, nor prevent yet a third fire-storm.

With considerable ingenuity, born of horror and desperation, the Luftwaffe had seized on hurried expedients to circumvent the chaos created by the RAF's use of 'Window', using free-lancing single-seat day fighters to attack the bombers which could be clearly seen silhouetted against the fires raging in Hamburg below. This and the broadcast to the night-fighters of a running commentary on the general course, height and position of the bomber stream, had met with increasing success, though RAF losses had remained low at 17, 27 and 37 respectively during the last three raids.

The statistics of the attacks speak for themselves. Out of 3,095 bombers despatched by the RAF, 2,630 had attacked, dropping 4,309 tons of incendiaries and 4,312 tons of high ex-

The shattered buildings of Hamburg loom over streets bulldozed clear of rubble. The RAF developed a standard treatment for a target city, first blowing the roofs off with blast bombs and then dropping incendiaries onto the exposed combustible interiors.

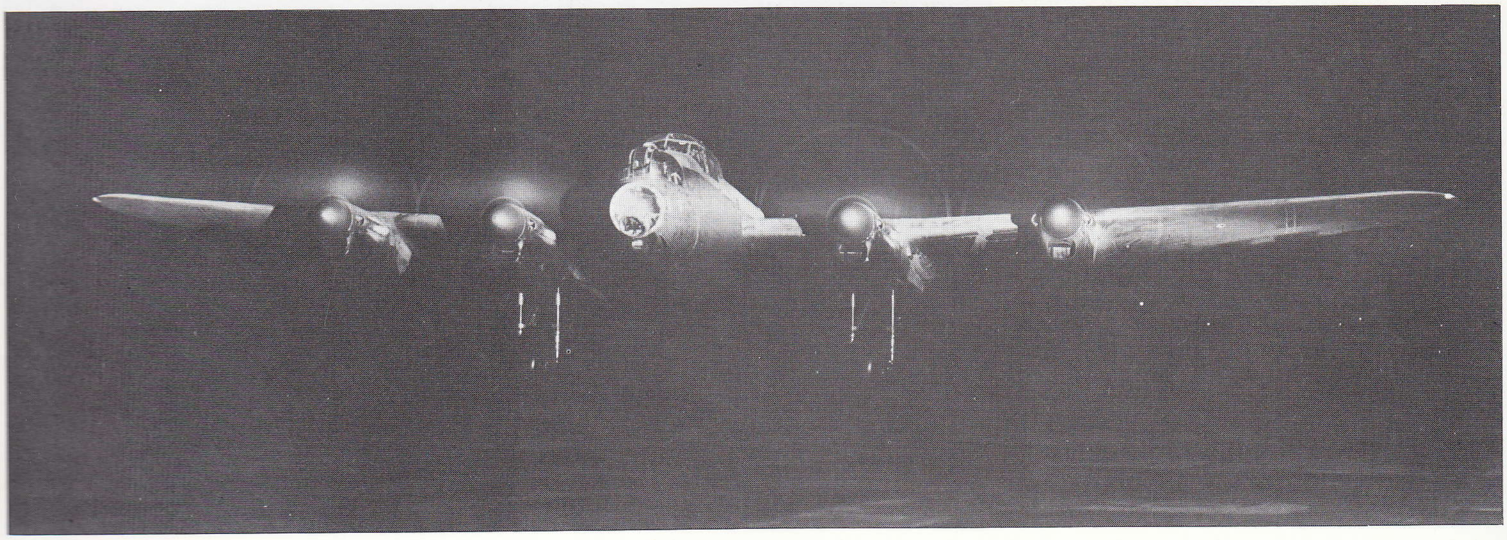
plosive. Damage in Hamburg was prodigious, with 40,385 residential houses and 275,000 flats (61 per cent of the city's residential acccommodation) destroyed or made uninhabitable; 580 industrial and armament plants were destroyed or rendered useless, as were 2,632 shops, 76 public offices, 24 hospitals, 277 schools, 58 churches and 83 banks. Twelve bridges were broken or made impassable, and the famous Hagenbeck Zoo destroyed,obliterated in the first great attack. Yet despite the initial casualty figures of 41,800 killed and 37,439 severely injured (of whom many were to succumb from the injuries suffered), Hamburg recovered with astonishing speed. Power supplies were restored to normal within six months and, despite a permanent loss of about 25 per cent of the working population (from death, injury and a loss of living accommodation), overall manufacturing output had recovered to some 70 per cent of the pre-raid effort within six weeks. Oil production fell by about 40 per cent for no more than a month.

In less quantifiable terms Operation 'Gomorrah' provided the UK with satisfying retribution. British civilian casualties from German raids suffered thus far in World War II stood at some 49,810 killed. The German dead in the Ruhr and Hamburg already far exceeded this figure. On the other hand, the Nazi propaganda chief, Josef Goebbels, confided in his diary that '*der Hamburger Zusammenbruch* (the catastrophe of Hamburg) simply staggered the imagination'.

Above: 746 bombers participated in the first attack on Hamburg on 24/25 July 1943. The bomber stream was over 300 km (200 miles) long and disguised its whereabouts from German radar by dropping 'Window', strips of metal foil cut to half the wavelength of the radar sets.

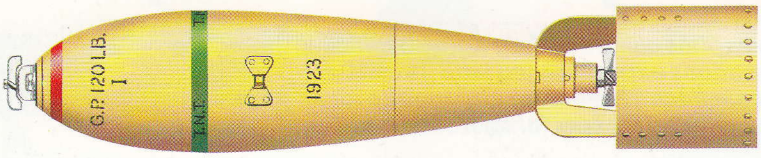
Left: A massed formation of the 305th Bombardment Group which participated in Operation 'Gomorrah'. The daylight raids complemented the RAF's night attacks by hampering Civil Defence and rescue efforts.

Below: An Avro Lancaster runs up for take-off on a mission to Hamburg. The Royal Air Force heavy bombers were always operated at night from the days of Virginias and Heyfords, and by the time of the bombing of Hamburg considerable experience had been built up.



UK

British standard bombs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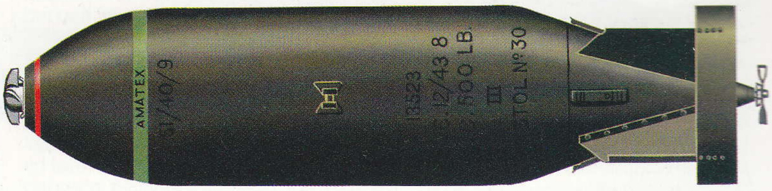
Left: The 54-kg (120-lb) GP HE bomb was one of a series of new, improved bombs of better aerodynamic shape than those used since World War I. This weapon replaced the old 50-kg (112-lb) GP bomb.



Right: The 227-kg (500-lb) MC, Mk III HE bomb was much more effective than the earlier 500-lb GP bomb, due to a higher filling-to-overall-weight ratio. The cropped annular vane permitted four of these bombs to be carried by the Mosquito bomber. It did not affect stability.

Although there existed in 1918 not only the 816.5-kg (1,800-lb) GP high-explosive bomb used principally by No. 207 Squadron RAF, together with the 1496.9-kg (3,300-lb) HE bomb intended to be delivered by the Handley Page V/1500, these were comparatively crude weapons. The art of bomb design was concentrated on the lighter types, so that at the outbreak of World War II offensive loads consisted in the main of bombs weighing 113.4 kg (250 lb) or 226.8 kg (500 lb).

Certainly there was still scope for the use of smaller free-fall bombs, and these particularly came into their own with the advent of the Hawker 'Hurribomber' equipped to take four 22.68-kg (50-lb) bombs under each wing.

Nevertheless, British bombs did present some variations of shape, and while the ones carried by fighters soon assumed near-conical noses with flattened fronts, the majority were of conventional appearance with 'egg-like' contours until the introduction of the 'thousand-pounder', the 453.6-kg type designed for the external racks of the Hawker Typhoon, all illustrations of the advancing state of the art in refining the shape of bombs for the RAF.

A degree of agreement was certainly evident concerning the design of that vital part of a bomb, the tail, and almost throughout the design of British standard bombs, the assembly here consisted of four sheet fins with a broad ring containing their trailing edges. These facts were in part dictated by the British practice of stowing bombs horizontally, the resultant release being the most aerodynamic that could be achieved, since a bomb dropping away from an aeroplane of the time inevitably spun or otherwise became unstable when struck by the slipstream; it was the tail that finally straightened its flight as the forward momentum imparted by the launch aircraft was lost and the downward path commenced in an arc towards the target as gravity exerted a pull. All these factors were common to the standard bombs of the day which were all of pre-1940 design and included the largely-forgotten HE type of 54 kg (120 lb); there were different versions of all types, some of these variants being readily identified from their casing that might have strengthening bands as on some '500-pounders'.

Specification

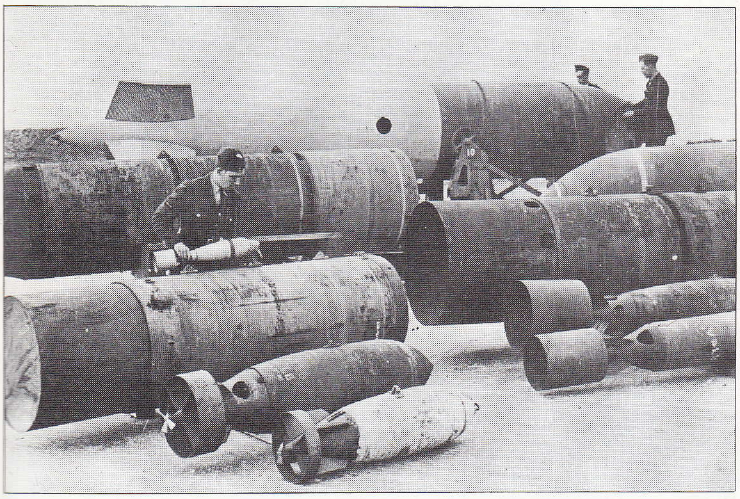
Mk 1 to Mk 3 GP

Type: general-purpose high explosive bomb

Weight: 119.4 kg (263 lb)

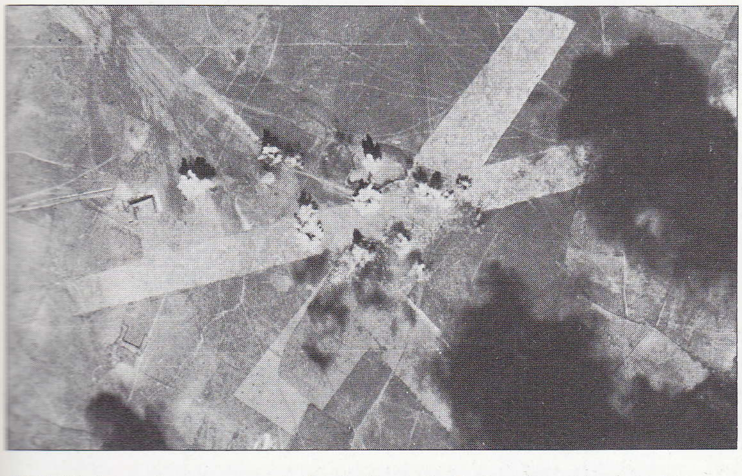
Dimensions: length 1.37 m (4 ft 6 in); diameter 0.26 m (10.3 in)

Filling: TNT or Amatol 80/20

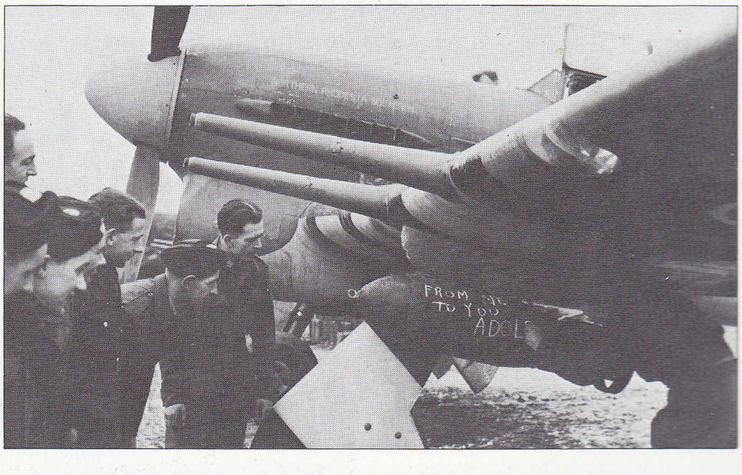


The bombs of the RAF. From the top: 9979-kg (22,000-lb) MC; 5443-kg (12,000-lb) HC; nose of 5443-kg (12,000-lb) MC; 3629-kg (8,000-lb) HC; 1814-kg (4,000-lb) HC; (right) 862-kg (1,900-lb) GP; 907-kg (2,000-lb) AP; (front) 454-kg (1,000-lb) and 227-kg (500-lb) GPs. The small bomb is 18 kg (40-lb).

454-kg (1,000-lb) MC bombs drop from an RAF bomber into the jungle of Burma. Earlier RAF bombs had long annular tail vanes, but by cropping the vanes of 227-kg (500-lb) bombs the bomb bay of Mosquitoes could accommodate four instead of two of these weapons.



Airfields have always presented a challenge to the bomber, proving very difficult to knock out. Lacking today's specialist weapons, the RAF had to rely on accuracy and delayed action bombs to frustrate repair work. Here, a stick of bombs impacts on a Japanese airfield in Burma.



A 227-kg (500-lb) Mk III MC bomb is loaded on the wing rack of a Hawker Typhoon. The pistol and detonator has not yet been installed in the nose of the bomb; the armed bomb had pistols and detonators in both nose and tail.

Special Purpose Weapons

Many of today's air-to-ground weapons can trace their ancestry back to munitions designed in World War II. Most nations experimented with guided weapons, the Germans deploying some to great effect. There were also unique ideas such as the Dambusters' 'Bouncing Bomb' produced for special operations.

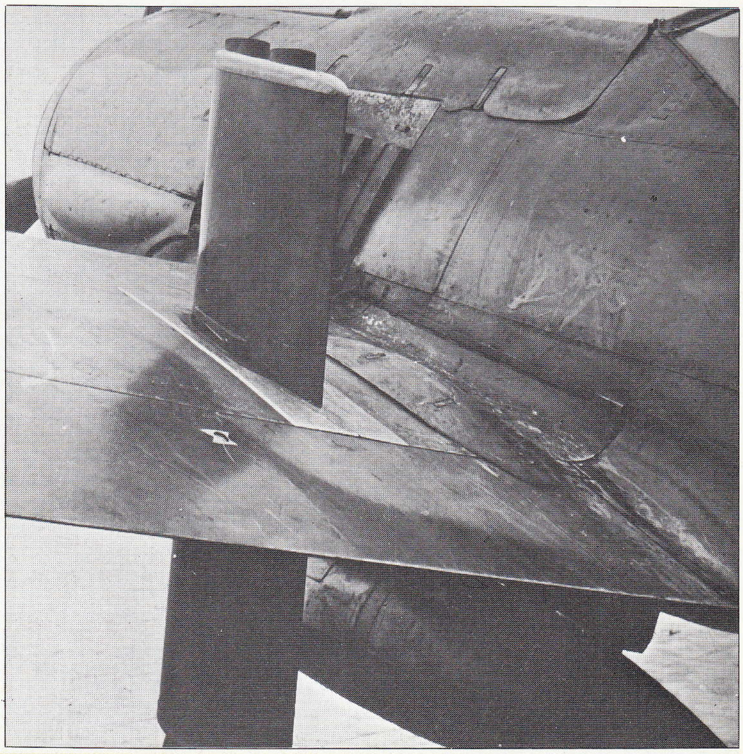
'Weary Willie' and 'Tired Tim' were a couple of much-beloved strip cartoon characters in the days before World War II, and it was probably the American custom of describing time-expired operational airframes as 'war weary' that led to the name 'Weary Willie' for the Boeing B-17s modified for remote-control crashing onto targets such as the underground lairs ('No-ball' targets) of weapons like the V-1 flying bomb. The relegated bombers were never in the event used for such work, but would have been packed with explosive and taken under radio control on their last mission.

But if such outsize flying bombs as these represent the larger of the special-purpose weapons, the other end of the scale is surely and ably represented by the tiny Razzle (and the larger Decker). These were incendiary devices intended for use against enemy crops and forests, and consisted of a small piece of wet cotton wool wrapped round a phosphorus pellet and enclosed within two sheets of celluloid about 7.6 cm (3 in) square. Some 450 such devices were carried in a drum of liquid and dropped over enemy territory, to lay on the ground undetected until they dried out and ignited.

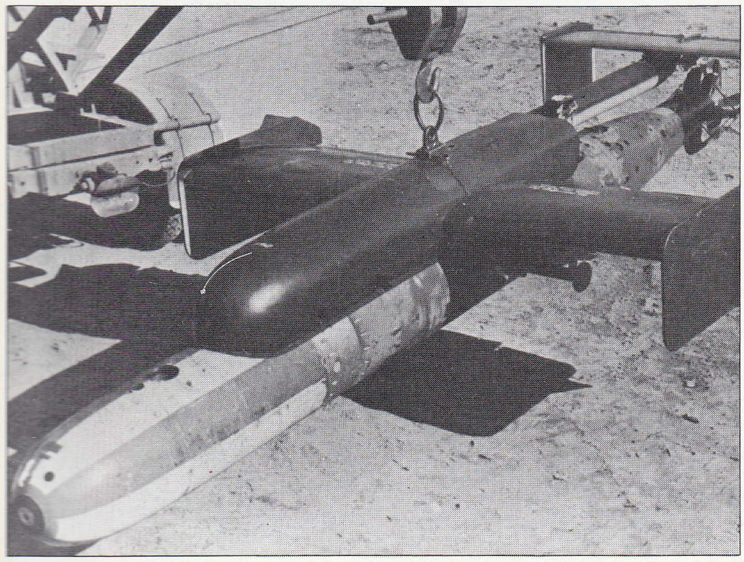
Yet undoubtedly the most famous special device of the entire conflict is the cylindrical bomb used to destroy the vital Ruhr dams.

Simple in concept, this Barnes Wallis design was little more than a metal cylinder, set spinning by means of a VSG Hydraulic motor via a 'V' belt. With 2994 kg (6,600 lb) of RDX explosive making up the greater part of the 4196 kg (9,250 lb) total, the bomb was capable of skipping over the protective booms at 500 rpm once released by the parting of the the pair of suspended trusses, to sink against the target wall and be fired by the hydrostatic fuses set to operate at a depth of 9.14 m (30 ft).

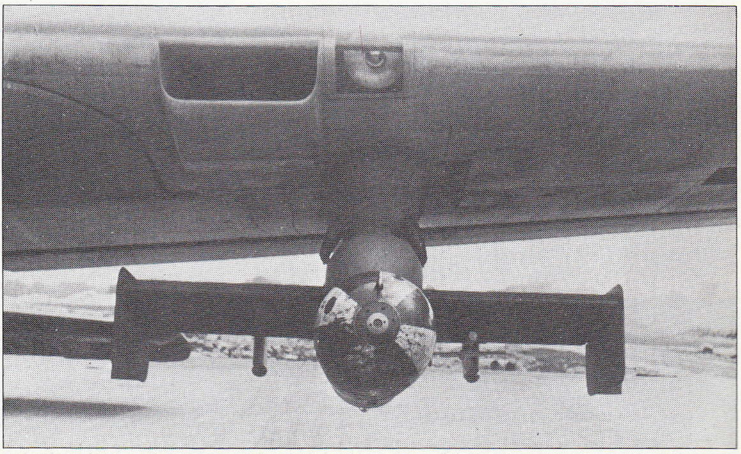
Another special weapon of similar concept was that intended to sink the *Tirpitz*. This preceded the larger bomb, and was codenamed 'Highball'. Of spheroidal shape, it was intended to be carried in pairs by an adapted de Havilland Mosquito. The delivery journey and dash back to base would be carried out at 4572-m (15,000-ft) altitude which, although probably alerting the enemy radar, would permit an enhanced range and improved flexibility of the actual attack. Unfortunately all came to nought although tests had been satisfactorily concluded, political pressures finally winning the day so that not even the squadron of special Mosquitoes despatched to operate against the Japanese fleet was ever used.



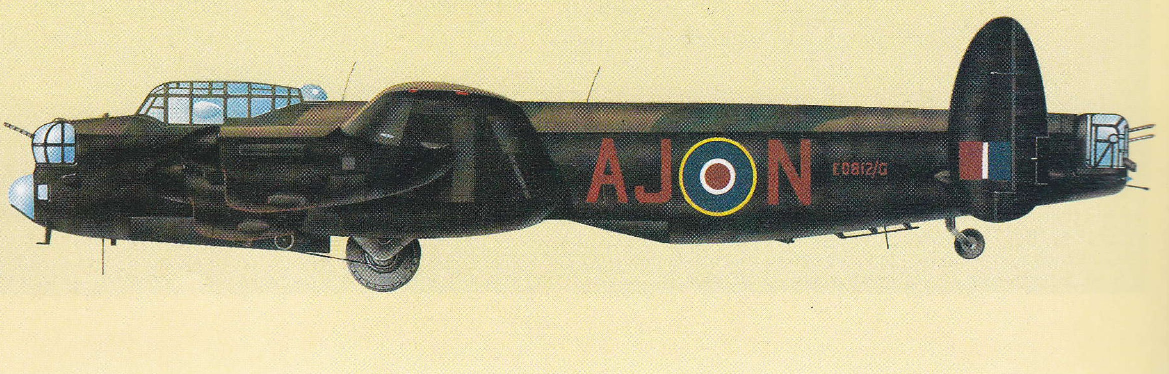
The SG 113A Förstersonde consisted of a pair of 77-mm recoilless guns mounted vertically in the wing of an FW 190 and triggered by the electro-magnetic field created by the mass of metal in a tank. It was successful in penetrating the armour of a captured T-34 tank, but was not adopted.



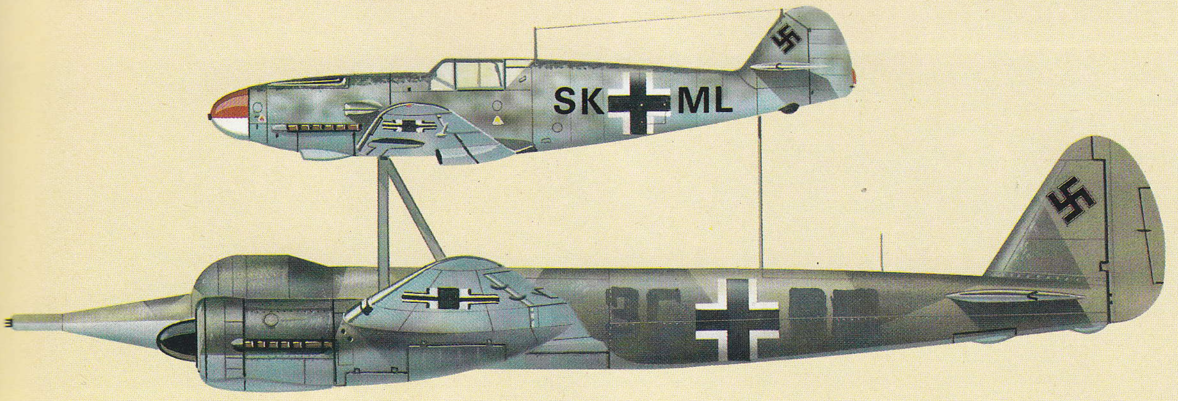
The L10/LT-1 combination weapon was developed by the Germans as a means of launching torpedoes from outside the area of anti-aircraft fire. The weapon consisted of a Blohm und Voss L10 glider carrying an LT-1 torpedo. The weapon was gyro-stabilized to glide at 15 degrees to the water.



On making contact with the water the LT-1 torpedo separated from the L10 and operated in the normal way. The weapon was extensively tested but was never used operationally, for reasons that are not apparent.



Arguably the most famous special purpose aerial weapon used during World War II was the 'Bouncing Bomb' designed by Dr Barnes Wallis and used to attack the Ruhr dams. The weapon is shown here beneath an Avro Lancaster of No. 617 Squadron piloted by P/O L.G. Knight, who breached the Eder dam.



'Mistel' (mistletoe) was the name the Germans gave to their combination system whereby a fighter aircraft was attached to an old bomber loaded with explosives. The fighter, in this case an Me 109, flew its charge to the target, broke contact and guided the bomber to impact by radio control.

The supply of special weapons was not in any measure confined to the Allies. For example, the Luftwaffe boasted that its largest conventional bomb, the 5,511-lb SC 2500 nicknamed 'Max' which was 3.895 m (12 ft 9.3 in) long and had a diameter of 0.829 m (2 ft 8.6 in), was too large to fit into the internal bay of any German bomber and thus had to be carried externally.

One of the special weapons associated with the night raids against the UK was that popularly known as the 'land mine'. This was an adapted device that was commonly spoken of in some awe because of its high blast effect; this was partly the result of the weapon's lack of penetration, since it was dropped under a large parachute of coarse green material secured to the thin-walled casing with plaited lines some 12.7-mm (0.5-in) thick. These weapons were frequently dropped in company with a percentage of 'oil bombs', fire-raising devices distinct from the normal thermite incendiaries of which an explosive version was introduced. The oil bombs carried both fuel-oil and phosphorus within a single casing. Another contemporary special weapon was the so-called 'Molotov cocktail', which consisted in the main of a high-explosive bomb with an attached container for conventional incendiaries which opened before making impact and thus scattered its load.

But perhaps the most dangerous special weapon to come from the German aerial armoury was quite small, the 'butterfly-bomb' or SD-2 which consisted of a cylinder no more than a few centimetres in diameter. Semi-circular 'wings' stowed round this casing opened in flight so that the bomb spun to the ground in the manner of a sycamore seed. These weapons proved of particular value against soft-skinned vehicles or troops in the open, detonation taking place on impact or after a delay; the weapons could also act as 'booby-traps', lying in undergrowth etc. until disturbed. Fighters or Junkers Ju 87s could lay a trail of up to 96 of these SD-2s, while twin-motor bombers could deposit some 360, a contrast in size and scope with such special weapons as the explosive-laden Grumman F6F Hellcats earmarked to fly unmanned against targets in the Pacific area.

Above: A parachute-retarded bomb drops onto Jofman Airfield in north west New Guinea. Here, these weapons are being used at very low altitude to permit the bomber to get clear before the bomb detonates amongst parked aircraft. The bombs are probably of the fragmentation type.

Below: The 'Weary Willie' idea of packing old B-17s with explosive and crashing them on to a target was abandoned in favour of more modest plans involving these Grumman F6F Hellcats. Too late for service in 1945, they saw action in the Korean War.

UK

British heavy bombs

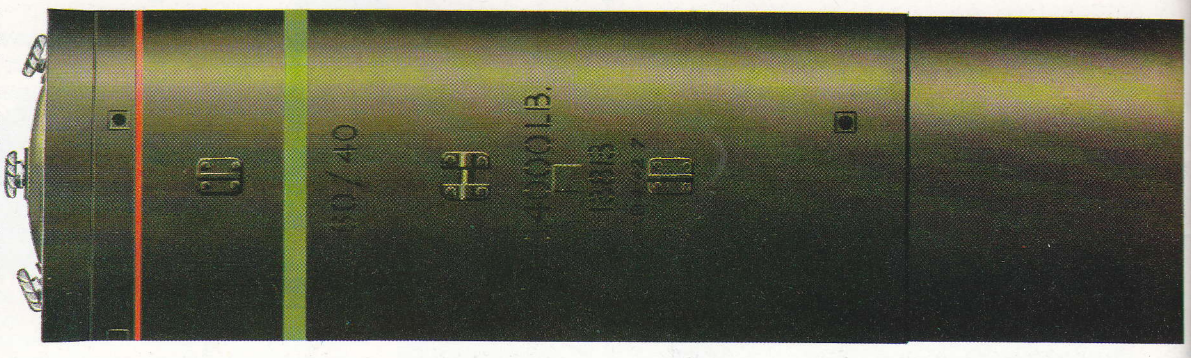
The largest of the British war-time bombs was the well-known 'Grand Slam', a 9979-kg (22,000-lb) missile designed chiefly for deep penetration, equipped with aerodynamically shaped fins to impart an assisting twist to its fall. Forty-one of these monsters were dropped by specially-modified Avro Lancasters in 1945, the first on 14 March when Lancaster B.Mk 1 (Special) PD112 of No. 617 Squadron, with Squadron-Leader C.C. Calder at the controls, demolished two spans of the Bielefeld Viaduct with one of these weapons only a single day after the first test-drop had been made.

British heavy bombs of 5443-kg (12,000-lb) capacity were of two types, the most sophisticated being the **'Tallboy'** designed for deep penetration, and of which no less than 854 were dropped by Avro Lancasters following the first attack with them on the night of 8/9 June 1944.

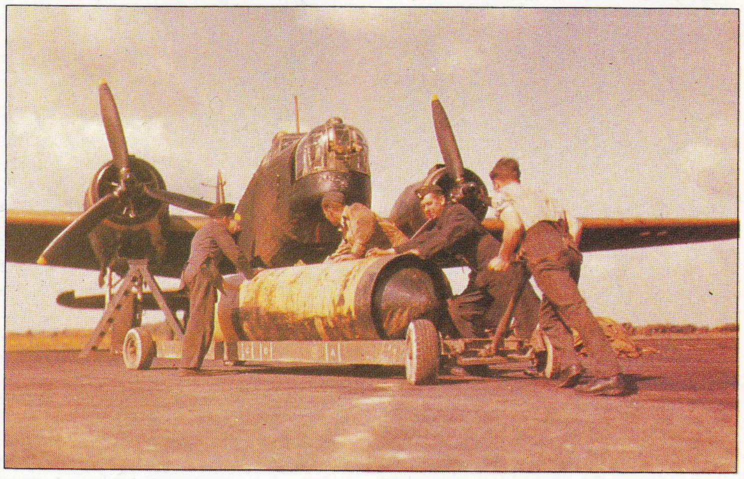
While the 'Tallboy' was of conventional streamlined shape, the other 5443-kg missile was a departure from common practice in that it was cylindrical and was in fact formed from three 1814-kg (4,000-lb) 'Cookies' bolted together (the sections being clearly visible) with an annular-ringed six-fin tail attached. This was the **General-Purpose 'Factory Buster'**, also much used in 1944, but in fact first used during a raid on the Dortmund-Ems Canal during the hours of darkness of 15/16 September in the previous year.

'Big, beautiful' bombs were pioneered by the 907-kg (2,000-lb) version first used during the night attack on the Emden shipyards on 31 March/1 April 1941. However, a comparison of weight alone is deceptive, since the explosive power of the later bomb was greater than that of the fillings used at the beginning of the war, when a 907-kg 'heavy' certainly existed in armour-piercing form for attacks on shipping, although the version of a mere 227-kg (500-lb) weapon was the accepted 'big bomb' in the RAF.

The ordinary **'Cookie'** had made its operational debut over Wilhelmshaven on 8 July 1942, observers at the time reporting that 'whole houses took to the air', thus gaining for the weapon the name of 'Block Buster' in the UK, although the Germans knew the type as *Bezirkbomben*. The existence of these was, however, not announced until some time after their first use, not in fact until September, and it was not for a further two years that the general public was to know the name of the man who had taken such a prominent part in the development of British war-time bombs, Air Commodore Patrick Huskinson, who had himself been blinded during a raid by the Luftwaffe in 1941.



Above: The 1814-kg (4,000-lb) HC Mk III HE bomb had three pistols and detonators in the nose. In the centre of the bomb there was a continuous tube with exploders linked into the central detonator. These bombs had a very high explosive filling to overall weight ratio.



Right: A 1814-kg (4,000-lb) HC Mk I high-explosive bomb is wheeled up to a Wellington B.Mk III. This was an early version with a single pistol and detonator in the nose. This example is painted in the yellow-buff shade originally used on high-explosive bombs.

Specification

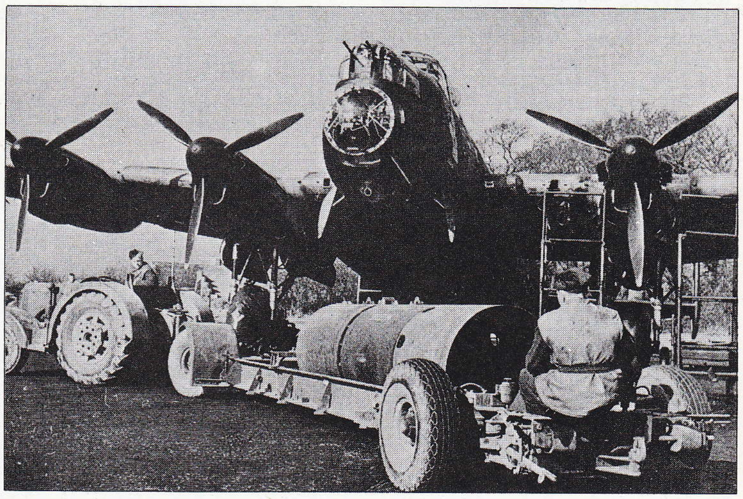
GP 'Factory Buster'

Type: general-purpose high explosive bomb

Weight: 5443 kg (12,000 lb)

Dimensions: length 5.33 m (17 ft 6 in); diameter 1.02 m (3 ft 4 in)

Filling: 2358.7 kg (5,200 lb) of Torpex 'cemented' within a 25.4-mm (1-in) jacket of TNT



A typical scene on any Lancaster base during later years of World War II: a 3629-kg (8,000-lb) HC blast bomb is brought up by tractor for loading into the capacious bomb bay of a Lancaster. The Lancaster, Manchester and Halifax could carry these bombs internally.

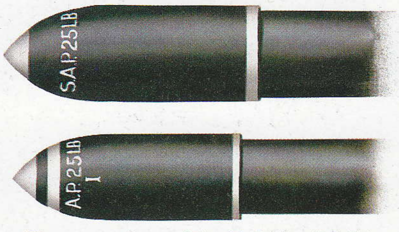
UK

British 25-lb rocket

British rockets employed a solid propellant inside a cast iron tube and mounted a variety of warheads and fuses. Their bodies were a length of 7.62-cm (3-in) diameter cast pipe fitted with a set of flat plate fins to constitute a cruciform tail, and a pair of lugs by means of which it was slung from the aircraft's launching rail. On one end was screwed the 11.34-kg (25-lb) armour-piercing warhead. A solid-propellant filling was packed into the length of pipe that made up the greater part of the missile, which was electrically fired in such a way that, although exhausting from the open end, burning was initiated from the front, a system necessary in order to ensure that the balance of the rocket was not disturbed as the charge was consumed. Concrete heads were employed for practice.

Experimental work took up the greater part of 1942, and included tests mounted under the wings of the new Hawker Typhoon, but it was the Hawker Hurricane that was to fly the rocket into action for the first time when aircraft of No. 184 Squadron made Fighter Command's first operational strike. Unfortunately the long rails necessary for launching exacted a serious penalty from the aircraft's performance, and except from a very steep dive the missiles were difficult to aim because of their sharp trajectory drop, aiming being by means of the standard Mk IIG reflector gunsight, which was not really equal to the demands made on it.

This British innovation was disliked by pilots because of its effect on performance, and there was a sharp temptation to expend them on the first available target, whatever it was, regardless of what warhead was being carried.



Three versions of the 11.34-kg (25-lb) warhead existed, two armour-piercing and one semi-armour-piercing. The AP shell no. 1, Mk I shown was used at dive angle of 15 degrees or over, while the AP shell no. 2, Mk I was used under 15 degrees. The SAP shown was for training only.

Specification

Type: air-to-ground aircraft-launched armour-piercing rocket

Warhead weight: 11.34 kg (25 lb)

Dimensions: length 1.69 m (5 ft 6.5 in); diameter 8.89 cm (3.5 in)

Aerial Anti-Tank Guns

Few tanks could afford to reduce their performance by the addition of thick top armour, and to exploit this weakness anti-tank cannon were fitted to ground attack aircraft. Automatic weapons of up to 40 mm (1.57 in) were fitted early in the war, and later on the Germans installed guns of up to 75-mm (2.95-in) calibre in specialist tank-busting aircraft to try to stem the Soviet advance.

Although arguably the most sophisticated air-to-ground weapon to come out of World War II was the German SG 131A device capable of detecting the magnetic field of a mass of metal, and therefore in effect to select its own target, in the main guns were favoured for the anti-tank role. These guns were fairly conventional, only the rate of fire, muzzle velocity and calibre being increased as armour became thicker.

Even so the array of these weapons was formidable, perhaps the best known being the 3.7-cm (1.457-in) Flak 18 cannon for anti-tank work, chiefly because a pair was slung under the wings of a Junkers Ju 87D (then redesignated Ju 87G). The BK 3,7 which was of the same calibre and both practical and effective, was also carried by some Henschel Hs 129B *Panzerjäger* as an alternative to the pair of 20-mm (0.787-in) MG151/20 cannon and two 7.92-mm (0.312-in) MG171 machine-guns more commonly carried. About a year before the end of the war, Henschels were also encountered with the 7.5-cm (2.95-in) BK 7,5 under the fuselage.

However, the gun most widely used for attacks on armour from the air by the Hs 129B (conceived in imitation of the Ilyushin Il-2, it might be added) was the single 30-mm (1.18-in) MK101, although the ammunition load was limited to a mere 30 rounds. Some were involved in anti-tank operations in the battle for Sevastopol where no important successes were achieved against Soviet armour, due chiefly to a proper technique being not yet adopted; and in September the aircraft were withdrawn for further crew training. In the meantime some BK 3,7 cannon were used, or 5-cm (1.969-in) BK 5s were carried, but the best results came with adoption of the MK103. Very similar to the MK101 from which it was developed, the MK103 had a higher muzzle velocity.

It was 1942 that saw some Messerschmitt Bf 110Gs fitted with a BK 3,7 under the fuselage, weight compensation being effected by the removal of the standard pair of 20-mm MG151 cannon under the nose.

Lesser-known anti-tank armament used by the Germans includes the Junkers Ju 88A-4 that was converted to take a KwK 39 gun of 7.5-cm calibre under the forward fuselage, where its large fairing replaced the normal bomb-aimer's gondola. There followed a small production run designated the Ju 88P-1 with a 7.5-cm PaK 40 gun, while the Ju 88P-2 was adapted to take two 3.7-cm BK guns instead.

Soviet anti-tank guns were almost synonymous with the various versions of the Il-2 *Shturmovik*, and these came to the fore during the Battle of Kursk in early July 1943 when the Germans threw in vast numbers of PzKpfw IV and some more modern tanks, plus Ferdinand self-propelled guns. Among all these the Il-2m3 aircraft with long-barrel 37-mm NS-37 cannon did massive execution, one German division reported to have lost 70 tanks in 20 minutes.

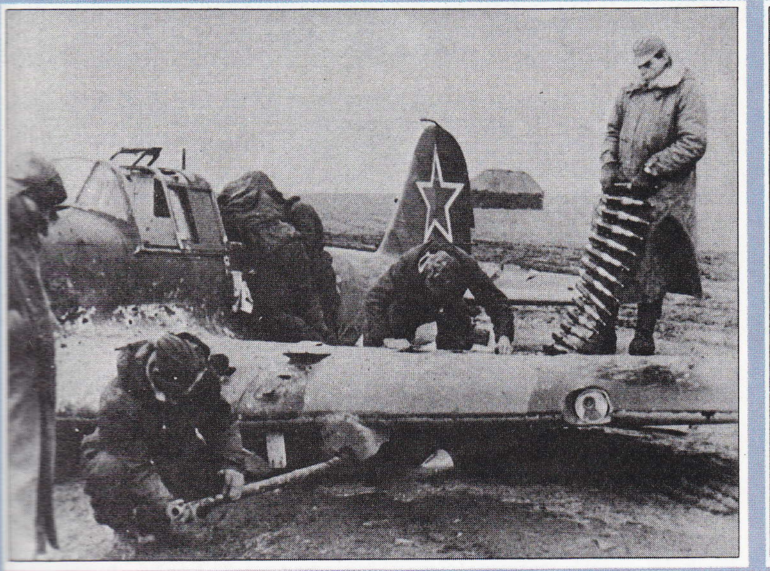
However, other Soviet cannon were carried by other versions of the *Shturmovik*, these including the 20-mm ShVAK and the 23-mm (0.906-in) VYa cannon. The lighter 12.7-mm (0.5-in) UBS machine-gun that was mounted to fire through the propeller disc of the Yakovlev Yak-9B fighter was also used for anti-tank work, but this merely supported the 20-mm ShVAK that was mounted to fire through the propeller shaft.

Hawker Hurricane Mk IID anti-tank aircraft are seen in the Middle East. The Mk IID was armed with two 40-mm Vickers guns with 15 rounds each, and two 0.303-in Browning guns with 330 rounds each. The Browning guns were used, with tracer, for sighting the big guns.

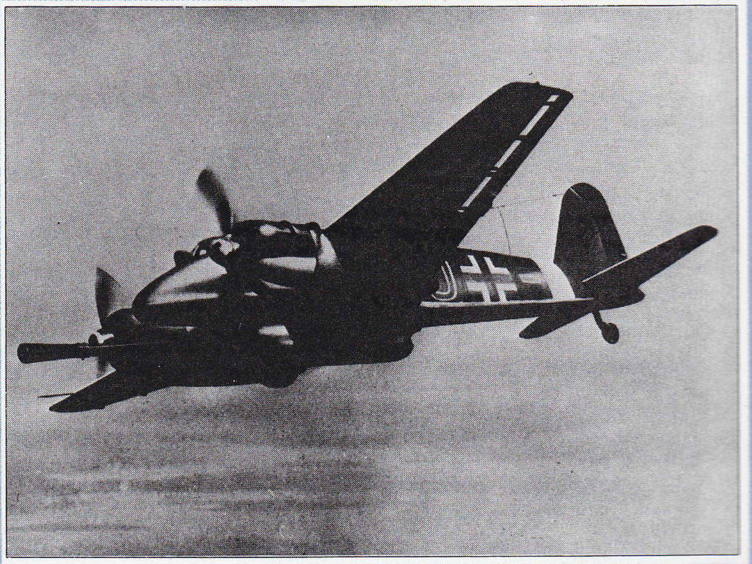
In this, the Yakovlev fighter-bomber was similar to another machine used for anti-tank work by Soviet pilots, the Bell P-39 Airacobra supplied from the USA under Lend-Lease from early 1942. Despite the alleged solenoid-trigger interference with the compass, the type was useful by virtue of its 37-mm M4 nose-mounted cannon, which was supported by a formidable array of six machine-guns, four of 7.62-mm (0.3-in) and two of 12.7-mm (0.5-in) calibre.

British attempts to introduce cannon had been something of a fiasco, and although these were only of 20-mm calibre, it was the hope that they could be used for ground-attack as well as the original air-to-air work that kept the project going when a host of feed troubles had to be overcome. It was the adoption of belt feed that enabled a more aerodynamic mounting of these Hispano weapons to be made in the Hawker Hurricane Mk IIC, although adequate recoil to operate the feed did present some continued problems.

Strangely, the 40-mm (1.575-in) gun was not widely used by the RAF, being confined mainly to operations in the Middle East. A Vickers product, it saw greatest service during 1942 and 1943 when such weapons were fitted to the specialist Hurricane Mk IID, on which their size made it necessary to sling them externally under the wings and below the centre of gravity where the recoil effected the trim of the machine, causing the nose to drop. The ammunition was based on that used by the Royal Navy, with the same cartridge case and primer as these were already in production, but a degree of redesign to this pre-1914 configuration was required when the original idea of a 40-mm cannon for air-to-air work was changed to include anti-tank use. In this the cannon was entirely successful, an armour-piercing shell weighing 1.106 kg (2.44 lb) being capable of penetrating 50 mm of armour at an angle of 30°.



The Ilyushin Il-2m3 anti-tank and ground attack aircraft was armed with two 37-mm NS-OKB-16-37 guns, with 32 rounds each. With this armament the Il-2 could destroy the majority of German tank types, including the Tiger I. The Il-2 could also carry rocket bombs.



The Henschel Hs 129B-3/Wa. anti-tank aircraft carried a modified PaK 401 75 mm anti-tank cannon, which had a rate of fire of 40 rounds per minute; 12 rounds were provided in the aircraft. Two 20-mm MG 151 cannon were also installed.

UK

British 60-lb rocket

With a similar basic concept to the 11.34-kg (25-lb) armour-piercing projectile, the rocket with a 27.22-kg (60-lb) high explosive head became standard after 1943, while later in the war fragmentation missiles of similar weights were introduced.

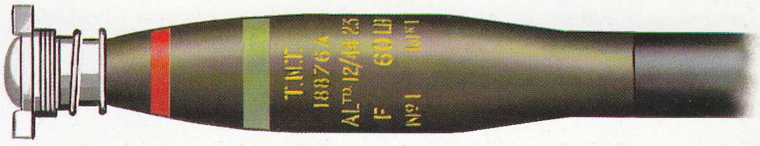
By this time a method of delivery designed to ensure maximum destruction of the target had been perfected. This called for the aircraft formation, now usually Typhoons, to make an approach at between 1829 m (6,000 ft) and 3048 m (10,000 ft), and from this the leader would make the first dive at about 40° to mark the target, he being followed at a similar angle at 644 km/h (400 mph) or at 30° when a lower speed of some 612 km/h (380 mph) was indicated. At an altitude of not more than 152 m (500 ft) and a distance of 500 m (550 yards) from the target the complete salvo, said to have a striking power equivalent to the broadside from a destroyer's guns, might be fired before the pilot pulled up sharply and took himself out of the radius of action, there being about five seconds before the shrapnel from the exploding rockets constituted a real danger to the aircraft that had launched them. Unfortunately it is on record that some 25 per cent of the rockets failed to detonate, particularly in the earlier days, and there was a definite tendency to undershoot and the trajectory drop to be inaccurately estimated.

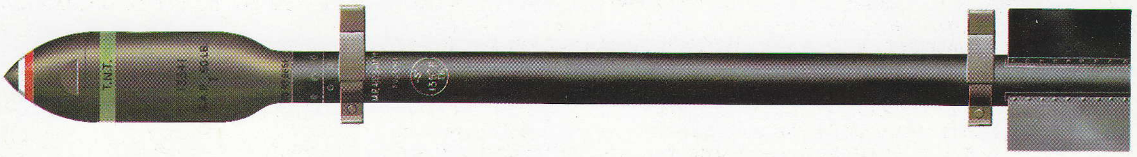
Before the end of the war, zero-length rocket rails were introduced which affected the aircraft's performance less markedly. Some of these revised the position of the missiles so that a load of four weapons under each wing was no longer carried side by side but instead, on the Mk 7 installation, fitted in two vertical pairs. A variation of this was to be found on the Mk 6 fitted to the Bristol Beaufighter, which grouped the four round a central fairing from which they could be jettisoned.

Developments of the basic 27.22-kg rocket included the 81.65-kg (180-lb) projectile with its three tubes of propellant, and the 'Admonitor' with seven motors inside a large diameter casing fitted with six fins, and having a 113.4-kg (250-lb) warhead.

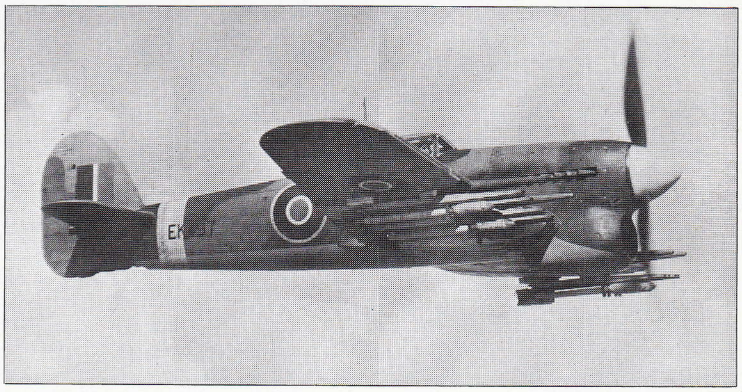
Specification

Type: air-to-ground aircraft-launched high explosive rocket
Warhead weight: 27.22 kg (60 lb)
Dimensions: length 1.88 m (6 ft 2 in); diameter 15.24 cm (6 in)

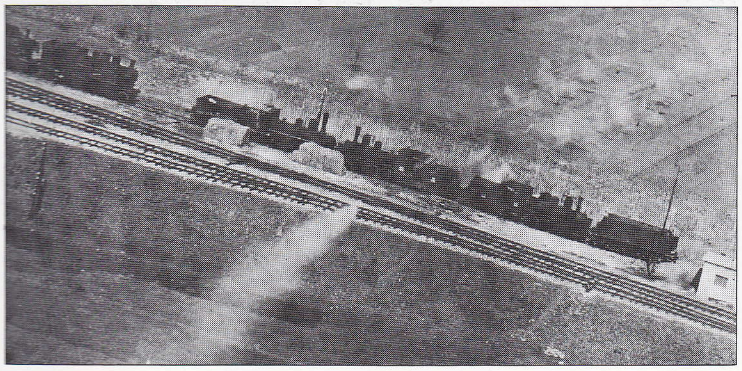




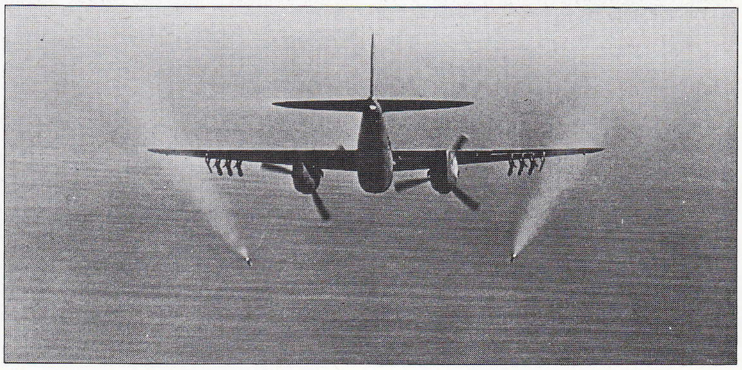
The 76.2-mm (3-in) rocket was used by the Royal Air Force for attacking a variety of targets, including ships, tanks, strongpoints, submarines and troop concentrations. A number of warheads were evolved for different types of target; the most-used was the 27.22-kg (60-lb) HE head shown here.



A Hawker Typhoon Mk IB, with the old 'car door' type canopy, carries 76.2-mm (3-in) rockets. The shells attached are the 27.22-kg (60-lb) SAP type. Other types used were the 27.22-kg (60-lb) 'F' fragmentation shell, 11.34-kg (25-lb) AP and 25-lb SAP shells, and concrete practice versions of these shells.

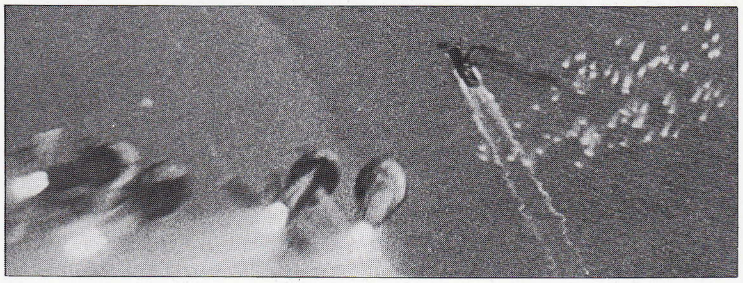


76.2-mm (3-in) rockets speed towards locomotives waiting in a siding, fired from a South African Air Force Beaufighter. The 27.22-kg (60-lb) shell was effective for penetrating locomotive boilers, but the 11.34-kg (25-lb) AP shell was specified for use against merchant ships and submarines.



For use against 'soft' targets the 27-kg (60-lb) HE Type F shell was developed. This was a thick-walled shell, which exploded into small high-velocity fragments. Pilots using this weapon were warned not to use it under 550 m (600 yards) because of flying fragments.

Left: Debris flies high in the air after a rocket strike by an SAAF Bristol Beaufighter against locomotives waiting in a siding. This locomotive target was in Yugoslavia during the German occupation of that country.



Above: Four rockets are launched from a Hawker Typhoon at a German barge on the Wester Schelde. These are 76.2-mm (3-in) aircraft rockets with 27.22-kg (60-lb) semi-armour-piercing shells. Heat from the rocket motor ignited the thermal initiator.

USA

American bombs

Observers in 1945 were in the habit of making comparison between what they called the 'superior aerodynamic shape' of British bombs and the more standardized lines of those dropped by the Luftwaffe. Be this as it may, the United States probably displayed the greatest variety of profiles among its free-fall bombs. Almost German in their appearance were the 907-kg (2,000-lb) **AN-M66** GPs used by the US Army and Navy; this type proved its value against ammunition dumps, railway junctions, airfields and factory sites, while a modified version of the AN-M66 could be fitted with an AN-Mk 230 hydrostatic fuse, enabling it to be employed against heavily armed surface vessels, as well as submarines. Either Amatol or TNT were the fillings used for this type.

The 454-kg (1,000-lb) general-purpose bomb resembled the larger version, but probably less closely than it did the 227-kg (500-lb) bomb with its squat construction and a semi-braced tail with sheet fins, which was really the typical United States weapon of World War II. Employed once more by both the US Army and Navy, these were used against similar targets to the larger versions, their nose fuses being in the main of AN-M103 pattern, although the AN-M125 long-delay time fuse could be substituted if the target justified such a change.

A feature of United States bombs, some of which were equipped with lugs permitting British-style single-point suspension, was that they carried an external arming wire. This ran fore and aft of the lifting lug position, where it was formed into an eye. From this point it was led through the twin suspension eyes to the nose and tail fuses. The weight of the released bomb tugged this wire free as it left the rack and thus armed the missile in a crude but effective safety system.

Both the **Mk 1** and **Mk 4** 'thousand-pounders' were declared obsolete in 1944, although they continued in service as long as bases held any in store, so that they remained in use until the end of the fighting in one theatre or another. These, in common with the majority of American bombs for general-purpose use, had a tail formed by four vanes welded to the tail cone which was fastened to the body by screws. A box form resulted from webs connecting the fins, and the whole was strut-braced internally.

At the opposite end of the scale of United States bombs mention must be made of the obsolete armour-piercing types forming the 'M' series. Of these the heaviest was the 408-kg (900-lb) **M6**, which like the rest of the group were converted artillery projectiles.

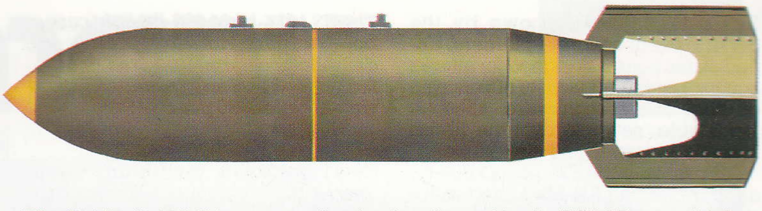
Specification

AN-M81

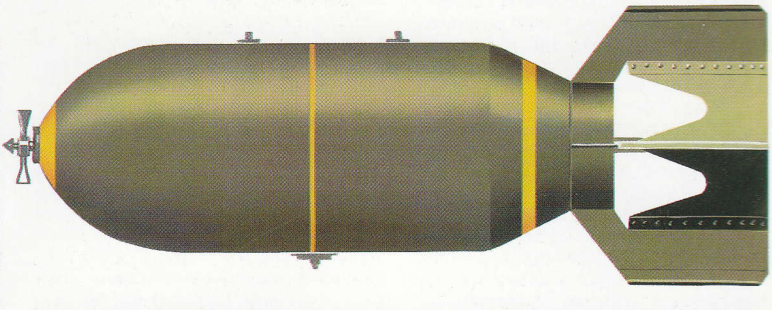
Type: high explosive fragmentation bomb

Weights: 117.9 kg (260 lb)

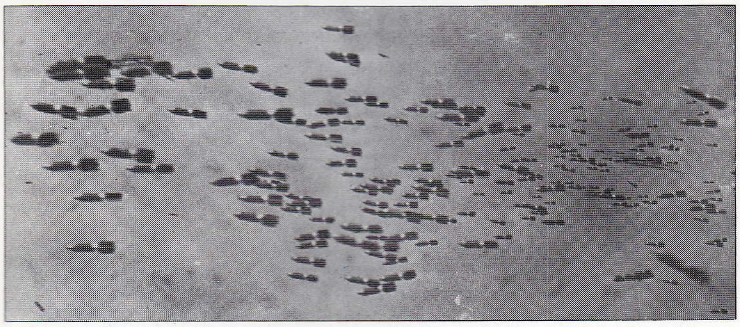
Dimensions: length 1.092 m (3 ft 7 in); diameter 0.203 m (8 in)



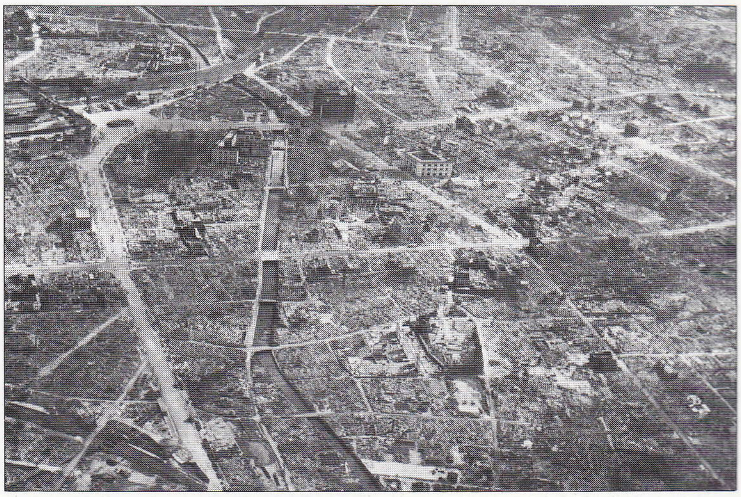
The 454-kg (1,000-lb) armour-piercing bomb used by the USAAF was a thick-cased weapon with an explosive filling to weight ratio of only 14 per cent.



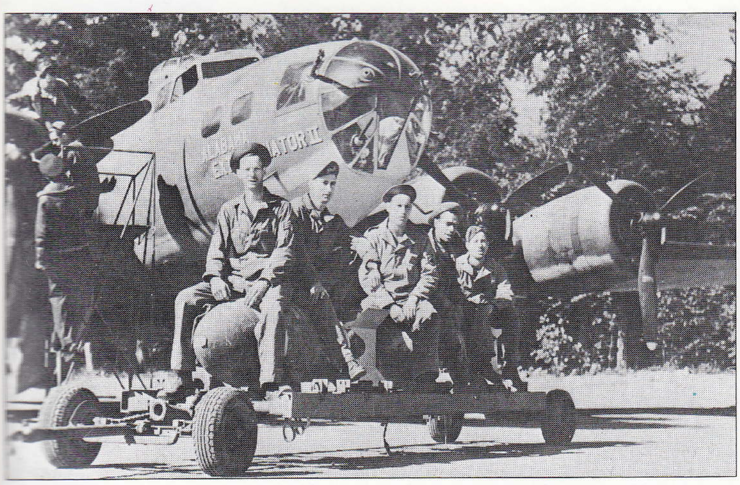
A typical general purpose bomb in use with US forces was the 227-kg (500-lb) weapon shown. It had an explosive filling to weight ratio of 51 per cent brought about by the use of a thin case. The bomb had two fuses, one in the nose and the other in the tail.



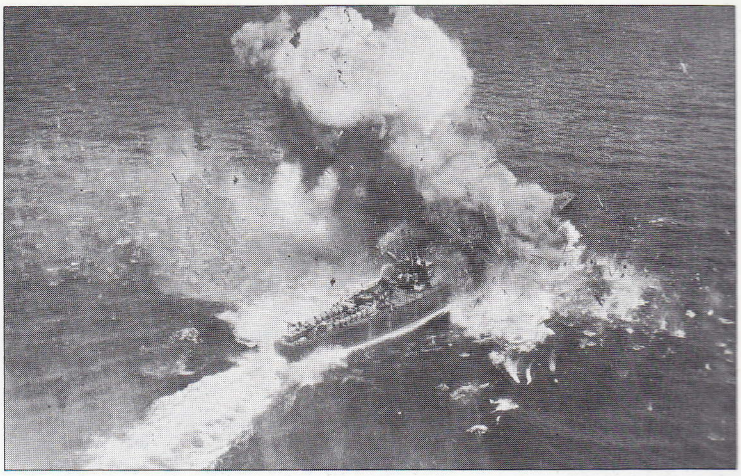
This shower of bombs descends from B-17s during an 8th Air Force raid on Germany in January 1945. Despite enormous advances in aiming techniques and navigational aids, errors still occurred and sometimes it was not only the wrong city that was bombed, but the wrong country.



The familiar pictures of Hiroshima have tended to obscure the fact that US conventional raids on Japan often caused greater destruction; this is Hammamatsu after a visit from the B-29 Superfortresses. Japanese cities proved horribly vulnerable to incendiary munitions.



Armourers ride on two 454-kg (1,000-lb) GP bombs being brought up for loading into Boeing B-17E day bombers of the United States Army Air Corps. The front bomb still has the transit plug fitted in the nose; this would have been replaced by the fuse and arming vane.



In the Pacific war the aircraft made little use of guided weapons, relying on torpedoes and accurate bombing. Here a Japanese escort takes a direct hit from a bomb dropped by a B-25 during an attack on a convoy off Leyte.

USA

American heavy bombs

Rapidly becoming known by the generic title of 'concrete-piercers', United States bombs designed for attacks against reinforced targets of concrete or steel construction were, although formidable, never to rival the British 'heavies' in power and size.

Largest was the 725.7-kg (1,600-lb) armour-piercing **AN-Mk 1** fitted with a single tail fuse, the AN-Mk 228 with a 0.08-second delay. Filled with pressed 'Explosive D' or TNT, the AN-Mk 1 was formed from a single piece of steel, forged and machined, with a pointed nose, parallel sides and slight boat tailing leading to a male-type base plate. To this was fitted the normal box type tail assembly while the body was equipped with side trunnions between the two suspension lugs on the upper segment, with British single point below.

Similar to this type in detail was the **AN-Mk 33**, 272 kg (600 lb) lighter but capable of being used against similar targets, which might also include battleships and cruisers. These smaller bombs were later modified (as were the Mk 1s) for suspension by means of screw-in lugs secured by bolts, thus replacing those of the welded type fitted to bands set in grooves in the casing.

A second type of 454-kg (1,000-lb) American bomb, intended for use against land targets of concrete or steel construction, was the SAP (semi-armour-piercing) type. This was capable of having an alternative fitting of either AN-M102A2 or AN-M103 fuses in the tail and nose respectively so that fragmentation could be achieved on suitable targets. These weapons were of single-piece cast or spun construction with streamlined, semi-pointed noses in which a threaded opening received a fuse-seat liner and steel plug, which could be exchanged for an instantaneous fuse if required.

A modified version of the generally similar **AN-M58** weighing only 227 kg (500 lb) was produced by the removal of 4.31 kg (9.5 lb) of the Amatol filling and replacing it with 14.29 kg (31.5 lb) of steel to improve penetration. They were then re-designated **AN-M58A1**.

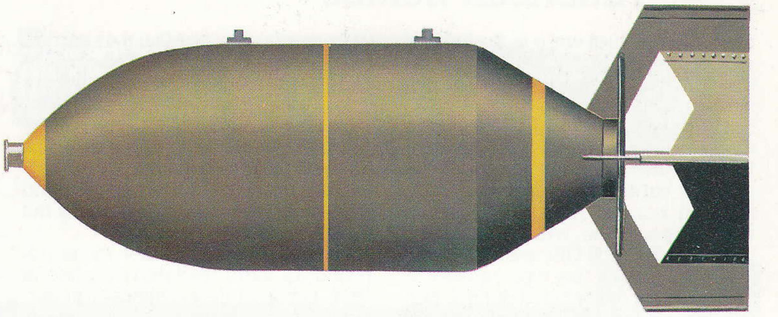
Specification
AN-Mk 1

Type: armour-piercing high explosive bomb

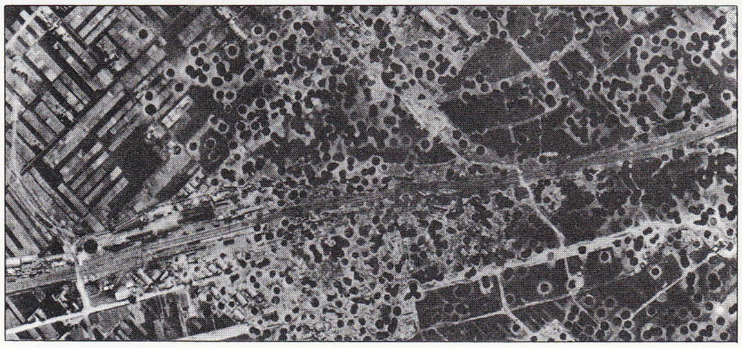
Weight: 721.2 kg (1,590 lb)

Dimensions: length 2.11 m (6 ft 11 in)

Filling: compressed explosive 'D' or cast TNT



The US 1814-kg (4,000-lb) light case bomb was used for large-scale demolition of targets such as factories. It had an explosive filling to weight ratio of 80 per cent.



A good example of the high concentration of bombing obtained by US day bombers: the target in this case was Marifu railyard, two miles south of Otaka, Japan, which was bombed by Boeing B-29s of the 21st Bombardment Group during August 1945.

USSR

Soviet rockets

The Soviet Union may well be able to claim that it pioneered the introduction of the rocket as a modern aerial weapon, but this was when they were envisaged as air-to-air weapons, tested first in 1937, the idea being that all fighters would be equipped to carry a battery of six to eight rockets on underwing launchers. They were to receive the designations **RS-75** and **RS-82**, the numerical suffix referring to their diameters, 75 mm (2.95 in) and 82 mm (3.23 in) respectively.

A ground-attack version was developed during the following year, and this was larger and of increased diameter. This **RS-132** was intended for fitting to bombers.

Meanwhile the RS-75 was used for the first time over Mongolia, during the Nomonhan Incident against Japanese aircraft, but although some successes were claimed, the RS-75 and RS-82 missiles ceased to be mentioned in reports after the opening months of the war against Germany, although their development was to make an important contribution in another field.

This took the form of a specialized ground-attack rocket, the **RBS-82**, that was introduced in 1941. It was from this that a new variant was produced with an improved velocity and increased propellant capacity as the armour-piercing **ROFS-132**, while much the same time saw the introduction of a version intended for use against concrete defensive positions, the **BETAB-150DS**.

It is perhaps not fully realized that one of the contributions to the acclaim heaped on the Ilyushin Il-2 aircraft as the war progressed was the type's effective use of 82-mm rockets, which were deployed with success against targets such as soft-skinned transport and troop concentrations, particularly if the latter were caught unprepared in the open.

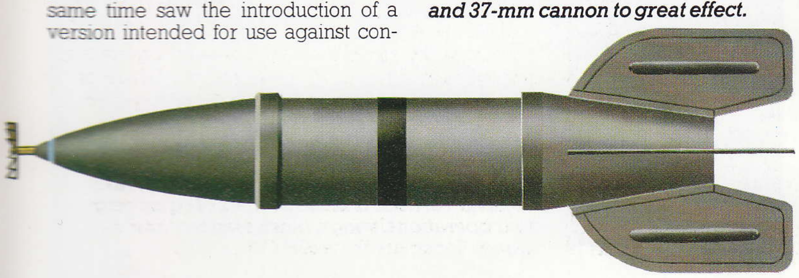
Introduced at a later date were the RS-132 variants: similar to the ROFS-132, these could be fitted with two types of head, the solid version being intended for building demolition, while that with a hollow-charge head was directed against armour.

Specification
RS-82

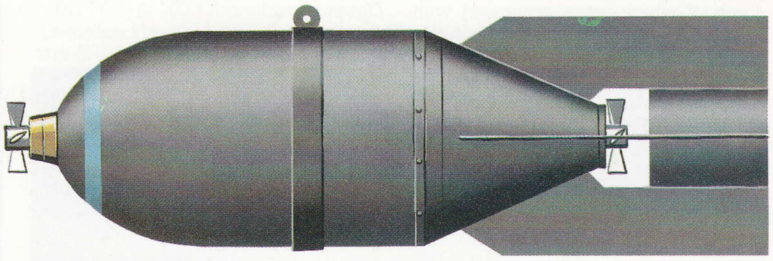
Type: air-to-ground aircraft-launched rocket

Weight: 24.9 kg (55 lb)

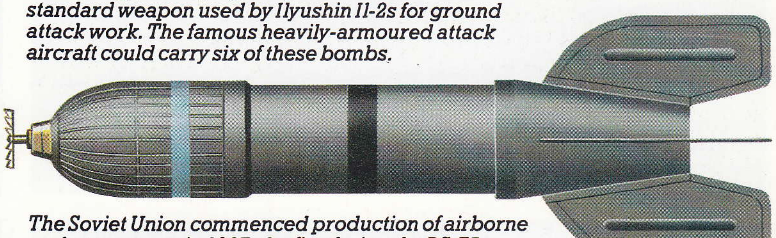
Dimensions: length 0.864 m (2 ft 10 in); diameter 82 mm (3.23 in)



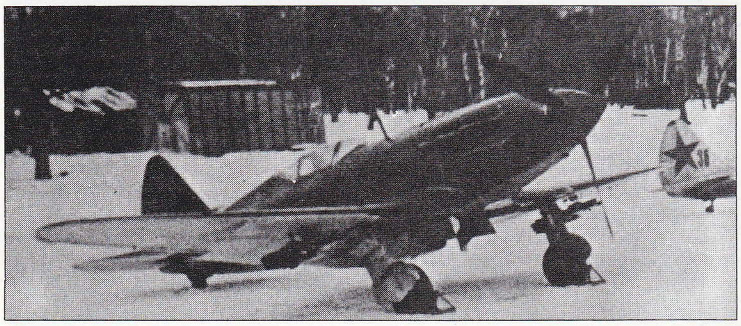
The Soviet Union's rocket weapons for airborne use were produced in three sizes, RS-75, RS-82 and RS-132, the numerals denoting the diameter in millimetres. The RS-132 shown has an explosive head for piercing strongpoints. Il-2s used these bombs and 37-mm cannon to great effect.



The 100-kg (220-lb) high-explosive bomb was a standard weapon used by Ilyushin Il-2s for ground attack work. The famous heavily-armoured attack aircraft could carry six of these bombs.



The Soviet Union commenced production of airborne rocket weapons in 1937, the first being the RS-75, a 750-mm diameter rocket. At first this was used for air-to-air combat, but later these weapons were used for ground attack. The rocket shown is equipped with a fragmentation head.



A MiG-3 of the 12th Fighter Regiment in 1942 carries RS-82 rocket weapons under the wings. This 82-mm rocket could be used as an air-to-air or air-to-ground weapon. Firings of rockets of 75, 82 and 132-mm diameter began in the USSR in 1933, and the RS-75 was first produced in 1937.

West Germany

Part 2

The Air Force

A vital component in NATO's front-line strength, West Germany fields an air force of 1,200 aircraft, 650 of which are combat-capable. The number is to be reduced slightly as replacement continues of Lockheed Starfighters by a smaller number of Panavia Tornados, but strike/attack potential will be considerably enhanced. In order to maintain an efficient fighting force, a 15-year defence programme has just begun, the major features of which will include 200 new fighters designated JF-90; a replacement tactical reconnaissance system; and new jet trainers. The JF-90 will almost certainly be provided by a European programme and will involve 144 aircraft, plus reserves and a training allocation, for four operational wings.

In its present form, the Luftwaffe comprises three major commands: Taktische Luftflotten Kommando (Tactical Air Force Command); Luftflottenamt (Air Force General Office); and Luftwaffe Unterstützungskommando (Air Force Support Command), which has no flying units. Tactical Command operates all the combat aircraft, sub-divided into Nr 1 Luftwaffe Division for attack units in the south of the country; Nr 3 LwDiv for northern attack units; Nr 2 LwDiv for southern air-defence units; and Nr 4 LwDiv for northern air-defence units. In total, these administer eight fighter-bomber, two interceptor and two tactical reconnaissance wings (usually of two squadrons each), two OCUs and a training organization in the USA.

Time is now running out for the F-104 Starfighter, 916 of which were delivered, the greater proportion of them from European manufacture. Over 250 have been lost in accidents, as a result of which the Luftwaffe Starfighter has gained an unenviable reputation although, on balance, it is no more dangerous than the F-104s of other users. Only one fighter-bomber wing now flies the type: Jagdbombergeschwader (JBG) 34 at Memmingen, with a nominal strength of 54 F-104Gs and eight TF-104G trainers. Since 1983, however, extra TF-104Gs have been operated, following disbandment of the Starfighter conversion unit, Waffenschule 10. A small unit at Manching, Luftwaffenschleuse 11, is responsible for handling F-104s being prepared for transfer to Greece and Turkey.

The air forces of NATO constantly practise and refine operational techniques. Here a Luftwaffe McDonnell Douglas F-4F takes fuel from a USAF KC-135 Stratotanker above Northern Europe.

Completely overshadowing all other aircraft in the inventory is the Tornado, 228 of which are being received (together with 96 for the naval air arm) from production by MBB. Apart from nuclear weapons and conventional bombs, the Tornado will carry the bulky MW-1 stores dispenser under the belly for anti-armour and airfield attacks; Hughes Maverick ASMs; and, later, a stand-off stores dispenser. An electronic combat and reconnaissance (ECR) model is also being studied, in which jamming capability will be provided by the same ALQ-99 equipment fitted to the USAF's General Dynamics EF-111 Ravens.

Conversion to the Tornado as an aircraft is undertaken in the UK at the Trinational Tornado Training Establishment (TTTE), RAF Cottesmore, while weapon system instruction is the responsibility of JBG 38 at Jever. Some 22 German Tornados are based at Cottesmore, and a similar number with JBG 38. The Federal German navy formed the first Tornado wing, followed by the Luftwaffe's JBG 31, which was established at Norvenich in August 1983. JBG 31 (which is named in honour of the German air ace, Boelcke) was formerly a Starfighter wing, as was JBG 32 at Lechfeld, the recipient of Tornados in August 1985. At Büchel, JBG 33 relinquished its F-104s in April 1985 before receiving Tornados four months later, and it will be augmented (probably in 1987) by JBG 34 to complete the Tornado programme as currently envisaged.

McDonnell Douglas Phantoms are important elements of the combat force, including 79 of the 88 RF-4E tactical reconnaissance aircraft ordered in 1968 for Aufklärungsgeschwader 51 'Immelman' at Bremgarten and AG 52 at Leck. Beginning in 1979, these have been converted to dual-role capability with the addition of a weapon sight and equipment for external stores. Next, between 1973 and 1976, the Luftwaffe received 175 F-4Fs (of which 162 remain), half of them assigned to the fighter-bomber wings, JBG 35 at Pferdsfeld and JBG 36 at Hopsten. A further 10 F-4Es were bought in 1977, but these are operated in full USAF markings from George AFB, California, by the 35th FTW for training German personnel. After conversion, crews report to the Zentrale Ausbildungsstaffel (Central Training Squadron) at Hopsten, where they become accustomed to a European environment by flying in the F-4Fs of an extra (third) squadron of JBG 36. F-4Fs have recently completed an update programme to enable them to carry a wider range of weapons, including the Maverick ASM, the AIM-9L version of the Sidewinder AAM, and laser-guided bombs.

Destined to form the backbone of the Luftwaffe's strike/attack force to the end of the century, the Panavia Tornado is in the process of equipping four operational wings. Illustrated is a 'lizard'-camouflaged machine of JBG 31.

Synonymous with Luftwaffe operations over the last two decades, the Lockheed F-104G Starfighter has rapidly diminished in terms of front-line commitment as the Panavia Tornado has entered service. This is an aircraft of JBG 34, the last operational front-line unit.

Light attack missions are flown by the 175 Dassault-Breguet/Dornier Alpha Jets delivered up to January 1983. Conversion training is by JBG 49 at Fürstenfeldbrück (invariably shortened to 'Fürsty'), which also has a third squadron with Piaggio P.149D lightplanes and Dornier Do 28D-2 Skyservants for pilot screening and initial navigator training. (Most other wings have three or four Skyservants, from 90 remaining, for communications.) Weapons training takes place at Beja, in Portugal, on 18 Alpha Jets of Deutsche Luftwaffenkommando Beja, these being given the 'shadow' identity and base of JBG 44 at Leipheim in the event of wartime mobilization. The other Alpha Jet wings are JBG 41 at Husum and JBG 43 at Oldenburg, and their combat duties would additionally involve anti-helicopter operations.

Air-defence units include the F-4F Phantoms of Jagdgeschwader 71 'Richthofen' and JG 74 'Mölders', based at Wittmundhaven and Neuburg respectively, and armed with AIM-9L Sidewinders. The Luftwaffe has no medium-range radar-guided AAMs, and must rely on RAF Phantoms and USAF McDonnell Douglas F-15 Eagles, which have such a capability. However, JG 71 and 74 are 'war only' units, because the post-1945 Allied peace treaty, which the USSR insists on retaining, permits only RAF, USAF and French aircraft to police West German airspace. In the future, however, F-4Fs are to be modified with new radar and Hughes AIM-120 AMRAAMs to give an all-weather, look-down/shoot-down potential. On the ground, the Luftwaffe has 15 battalions (six regiments) of Raytheon MIM-23B Improved HAWK and Western Electric MIM-14B Nike-Hercules SAMs, the latter to be replaced later in the 1980s by Raytheon MIM-104 Patriots. Euromissile ROLAND SAMs are also being acquired for airfield defence, supplementing 20-mm cannon. Remaining Luftwaffe missiles are Martin MGM-31 Pershing 1A nuclear SSMs of Flugkörpergeschwader 1 at Landsberg and FKG 2 at Geilenkirchen. These wings share 72 launchers, but an imminent order for replacement Pershing 1Bs is expected to total only 65, on cost grounds.

In the second major air force command, the Luftwaffenamt, are the transport units, with a main fleet of 89 Transall C.160Ds and 110 Dornier-Bell UH-1D Iroquois helicopters, from 110 and 135 deliveries respectively. Twenty C.160s were transferred to Turkey in 1972, but the rest are being refurbished for service until 2010. Lufttransportgeschwader 61, 62 and 63 at Landsberg, Wunsdorf and Hohn share the C.160s, although LTG 61 has an additional squadron of 25 UH-1Ds, and LTG 62 maintains a transport training flight (also including Skyservants) with a detachment at Beja. The remaining three squadrons of UH-1Ds are at Ahlhorn with Hubschraubergeschwader 64 and the helicopter crew school (Hubschrauberschule). HG 64 is responsible for many of the SAR and base rescue flights of Iroquois helicopters detached to several airfields. VIP and long-distance flying is the responsibility of the Special Air Missions Squadron (Flugbereitschaftstaffel) at Cologne/Bonn Airport with four Boeing 707-320Cs, three VFW 614s, four Skyservants, four UH-1Ds, three Lockheed JetStars and six HFB 320 Hansas. The JetStars and Hansas are in the process of replacement by seven Canadair 601 Challengers.

Training operations at home are administered by the Ausbildungskommando within the Luftwaffenamt, flying being restricted to the 40 P.149Ds of JBG 49 used for grading at 'Fürsty'. Other activities are now in the USA, under the control of Tactical Command. After grading, students report to Nr 1 Ausbildungsgruppe USA, otherwise known as the 80th Flying Training Wing, USAF, at Sheppard AFB, Texas. The 80th FTW operates some 40 each of Cessna T-37Bs and Northrop T-38A Talons remaining from 47 and 46, respectively, bought with German funds and painted in USAF markings. Pilots fly 132 hours on T-37s and an advanced course of 130 hours with the T-38, although plans are in hand to acquire new trainers in the course of the current 15-year defence programme. The 10 F-4E Phantoms at George AFB are known as Nr 3 Ausbildungsgruppe.

Miscellaneous aircraft to be seen in service include seven Hansas fitted for ECM training and operated by the Flugmessstaffel at Lechfeld, where it is attached to the Tornado wing, JBG 32. There are also two BAC Canberra B.Mk 2s used for survey work by the Military Geographic Office (MilGeoAmt) from Schleswig-Jagel; and 16 Rockwell OV-10B Broncos and 24 Fiat G91R/Ts at Lübeck and Husum, flown by civilian firms in the target facilities role. Lastly, there is Erprobungsstelle 61 at Manching, which is the central military aircraft test establishment, operating a small fleet of current operational types and a few back-up aircraft.

Luftwaffe flying units

Unit	*Equipment*	*Base*
JBG 31	Tornado	Norvenich
JBG 32	Tornado	Lechfeld
3./JBG 32	HFB 320ECM	Lechfeld
JBG 33	Tornado	Büchel
JBG 34	F-104 Starfighter	Memmingen
JBG 35	F-4F Phantom	Pferdsfeld
JBG 36	F-4F Phantom	Hopsten
JBG 38	Tornado	Jever
JBG 41	Alpha Jet	Husum
JBG 43	Alpha Jet	Oldenburg
(JBG 44*)	Alpha Jet	(Leipheim)
JBG 49	Alpha Jet	Fürstenfeldbrück
3./JBG 49	P.149D/Skyservant	Fürstenfeldbrück
AG 51	RF-4E Phantom	Bremgarten
AG 52	RF-4E Phantom	Leck
LTG 61	Transall C.160D	Landsberg
3./LTG 61	UH-1D Iroquois	Landsberg
LTG 62	Transall C.160D	Wunstorf
2./LTG 62	C.160D/Skyservant	Wunstorf (Detachment at Beja)
LTG 63	Transall C.160D	Hohn
HG 64	UH-1D Iroquois	Ahlhorn
JG 71	F-4F Phantom	Wittmundhaven
JG 74	F-4F Phantom	Neuburg
FBS	Boeing 707, Hansa, VFW 614, Skyservant JetStar	Cologne/Bonn
1.AusbStff	T-37, T-38 Talon	Sheppard AFB
2.AusbStff	F-4E Phantom	George AFB
TTTE	Tornado	RAF Cottesmore
LwS 11	F-104 Starfighter	Manching
EStelle 61	various	Manching

Luftwaffe missile units

FKG 1	Pershing 1A	Landsberg
FKG 2	Pershing 1A	Geilenkirchen
FRR 1	Improved HAWK	Freising
FRR 2	Nike-Hercules	Lich
FRR 3	Improved HAWK	Heide
FRR 4	Improved HAWK	Bremervörde
FRR 13	Nike-Hercules	Soest
FRR 14	Nike-Hercules	Oldenburg

* 'shadow' for DtLwKdo Beja

Abbreviations

AG	Aufklärungsgeschwader (reconnaissance wing)
AusbStff	Ausbildungsstaffel (training squadron)
EStelle	Erprobungsstelle (experimental establishment)
FBS	Flugbereitschaftstaffel (special air missions squadron)
FKG	Flugkörpergeschwader (missile wing)
FRR	Flugabwehrraketenregiment (anti-aircraft missile regiment)
HG	Hubschraubergeschwader (helicopter wing)
JG	Jagdgeschwader (interceptor wing)
JBG	Jagdbombergeschwader (fighter-bomber wing)
LTG	Lufttransportgeschwader (air transport wing)
LwS	Luftwaffenschleuse (air force forwarding unit)